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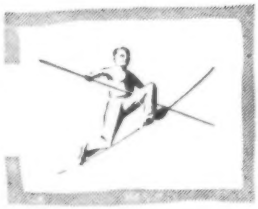

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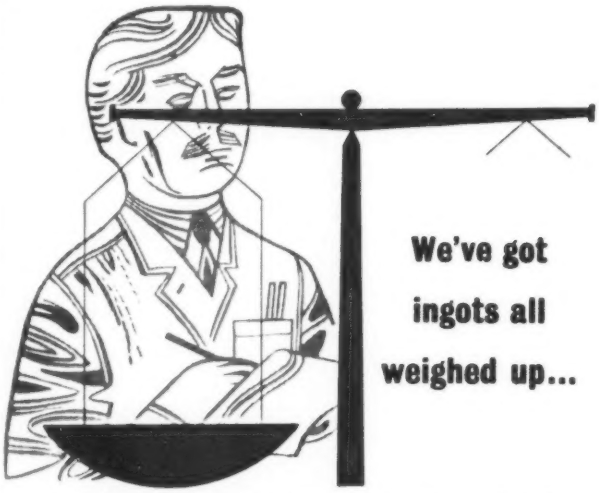

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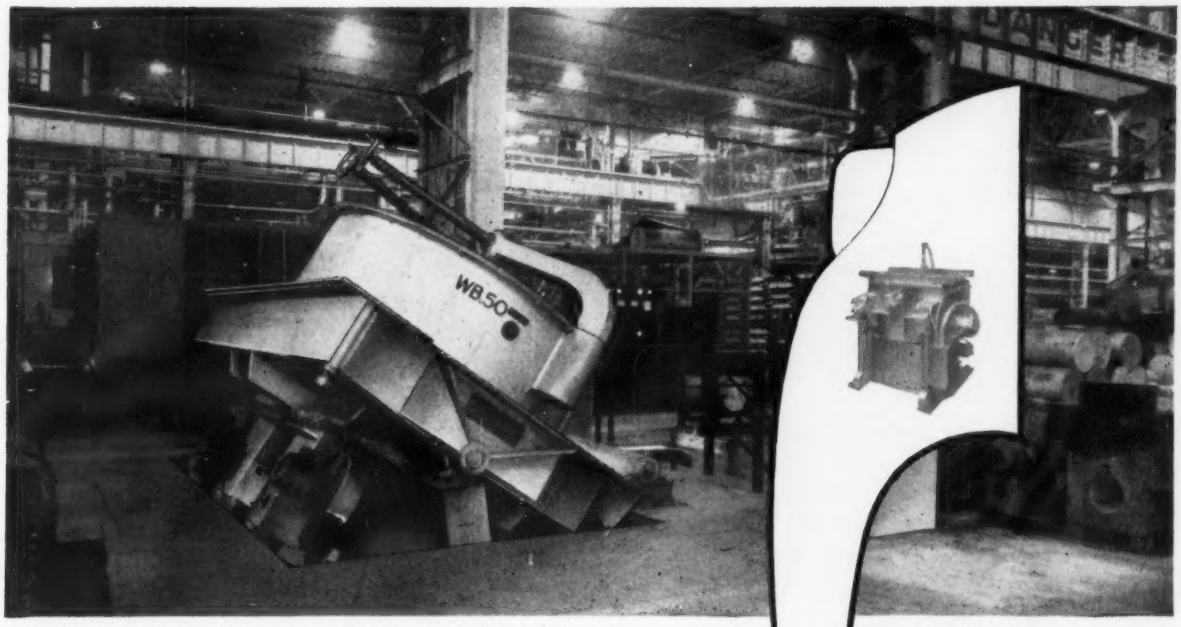

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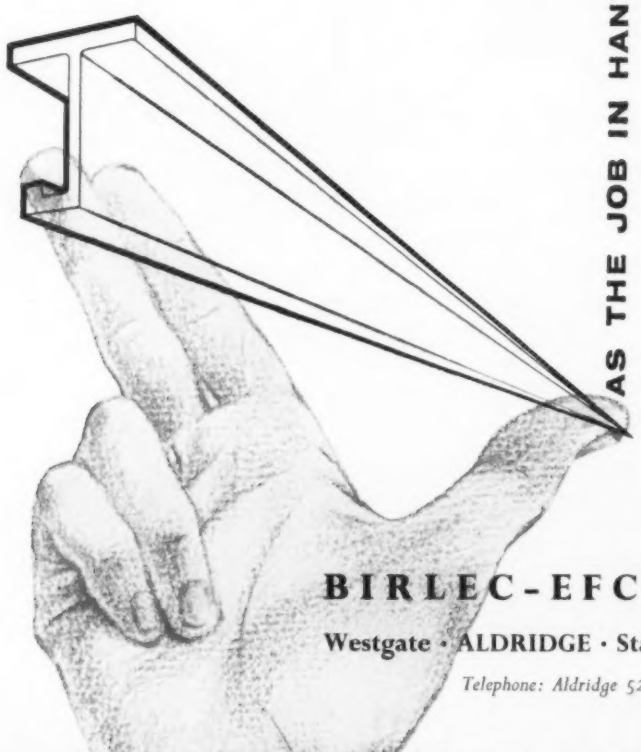

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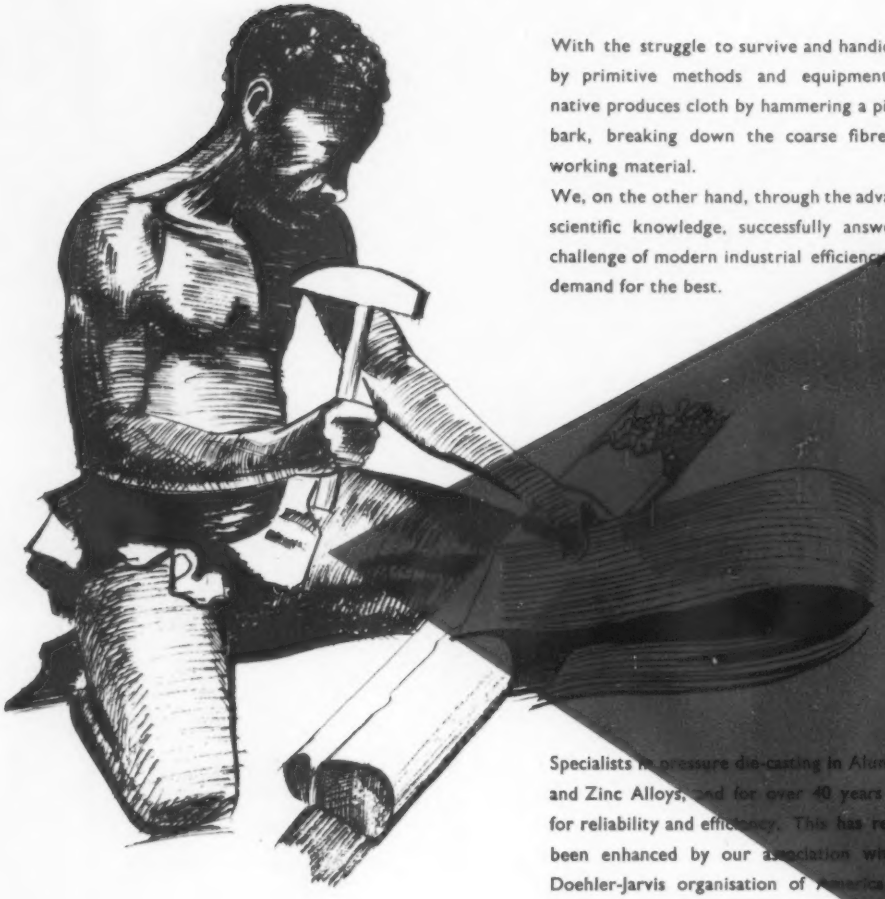

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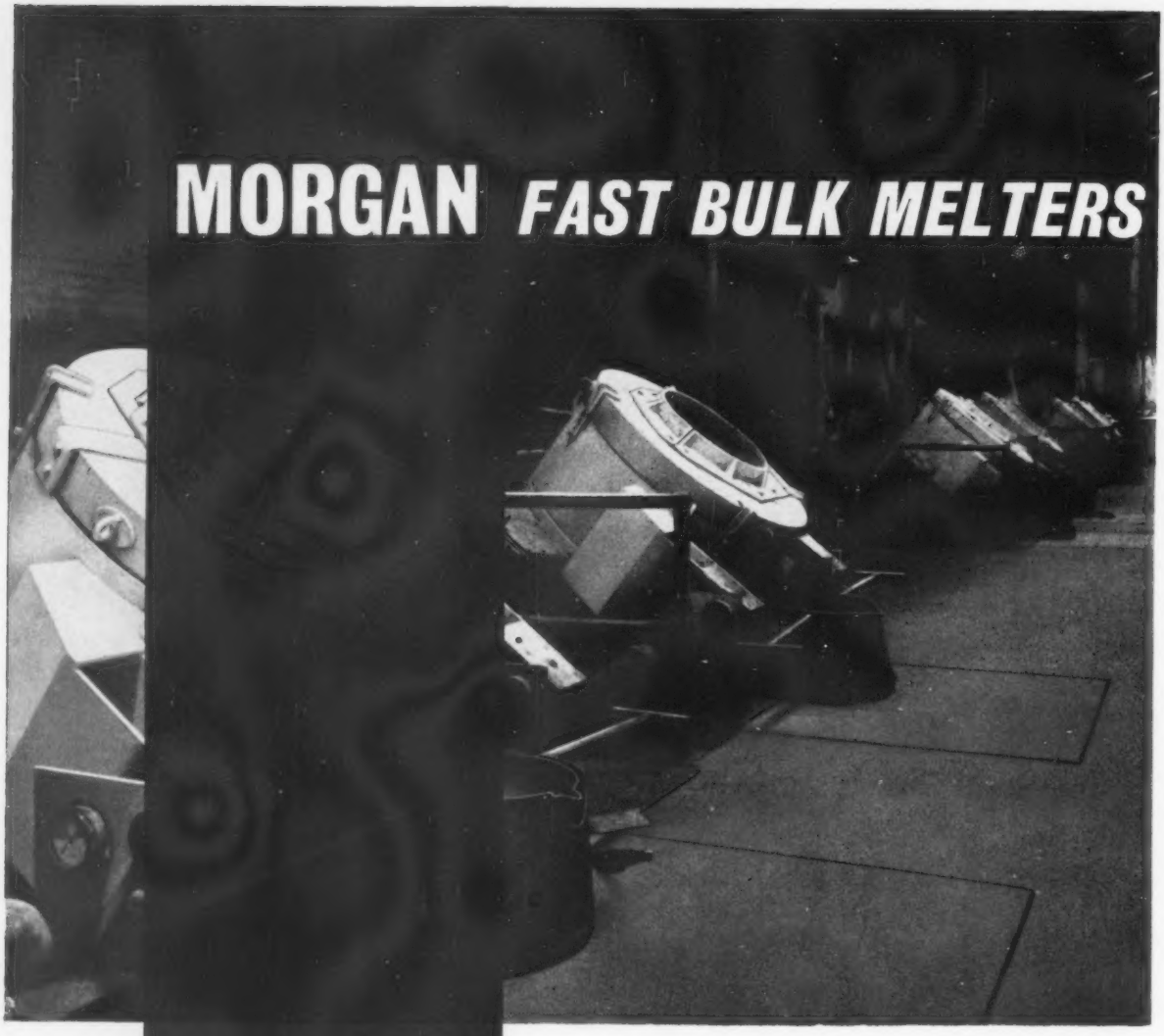

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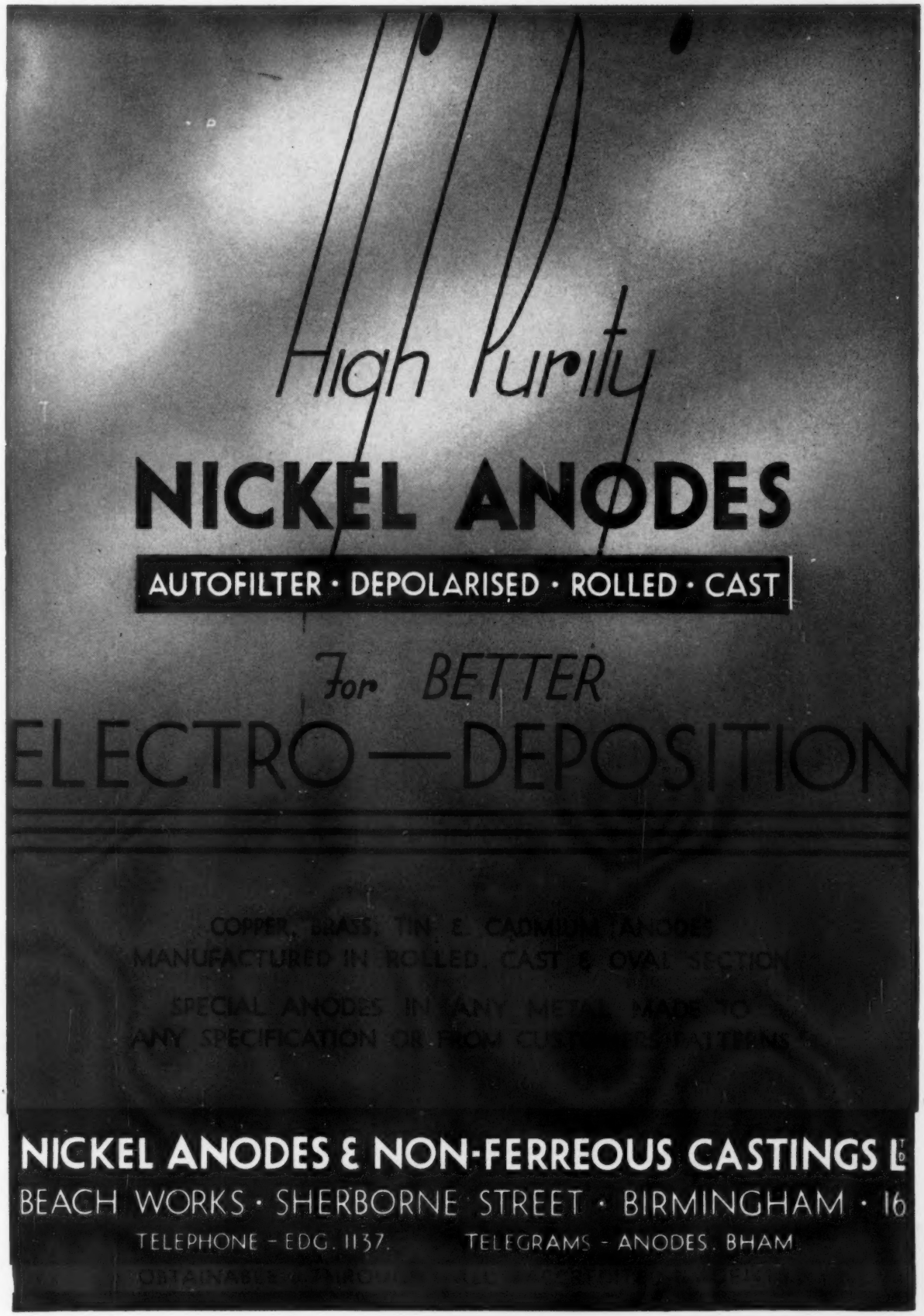
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In some cases the existing procedure of a producer is accepted as the best practice of the art and is taken as a basis for the standard in question. Thus British Standard 1004 (Zinc Alloys for Die Casting) was based on the established practice of the Imperial Smelting Corporation in the production of Mazak.

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METAL INDUSTRY

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VOLUME 99

NUMBER 16

Electric Heating

DESPITE an investment rate as high or higher than that of comparable countries, overall productivity in the U.K. has remained relatively stagnant, and a series of economic crises prompts the question as to whether investment is being put to the best use. The question really is whether there is still too much reliance on traditional processes, even where plant replacement has been decided, and a lack of investigation into newer and alternative methods now available.

In the heating field, management must realize that fuel cost is not the sole criterion of the efficiency of a process, nor even necessarily the main ingredient in the overall production cost schedule, and the need for more semi- or fully-automatic processing, for improved quality of product, for improved working conditions to retain, and get the best from, labour, and for the development of new or improved products must be paid more than lip service if we are to withstand overseas competition, whether from outside or inside the Common Market.

Overall production efficiency comprises many factors, some of which are not always apparent when a process is first considered. A simple example in the non-ferrous melting field, is that of type-metal in a newspaper foundry. Many of the 3-5 ton baths feeding autoplate machines have been converted from fuel firing by the use of thermostatically-controlled electric immersion heaters. The removal of heat generation from outside to inside of the bath means a longer bath life, and the absence of pipes and burners means that the bath can be more efficiently lagged. No flue is necessary, and the bath can be given full cover. Improved temperature control and uniformity, and the avoidance of combustion products drawn over the surface of the metal, leads to reduced dross. The absence of flues and pipelines, and reduced heat losses, greatly improve working conditions, and less floor space is taken up. Moreover, since casting generally takes place before the printing presses start up, the peak electricity demands of the melting and printing processes do not coincide and the electrical load factor—defined as the unit consumption over a period divided by what the consumption would have been if it had continued at the level of the peak demand in that period—is thereby improved. As the bath heating is at unity power factor, it makes up for the lower power factor of the press drives and raises the overall figure.

It is wrong to estimate the consumption cost of some new electrical plant under consideration on the basis of the average unit charge incurred by the factory for its existing plant; the peak demand of the new plant might not coincide with the factory peak, or its added consumption might be chargeable wholly or partly on a lower step of the unit rate. Many electric heating processes operate at a better load factor than other electrical factory loads, and hence can reduce the average cost of current; in some cases, the processes can be so programmed or controlled that their peak demands do not fully coincide, without detriment to production schedules.

Electric Heating for Non-Ferrous Metals

By J. T. Sharples, B.Sc. Tech., A.M.I.E.E.

ELECTRICITY is unique in the extent to which it can provide alternative ways of heating a charge. There are many examples to show that electrification has brought the following benefits: reduced maintenance costs, reduced floor space requirements, improvement of thermal efficiency and reduction of heat loss, reduced rejects and general raising of quality, all with lower labour cost. This article summarizes the current applications of electricity in the non-ferrous field.

Induction Heating

Induction heating, the method in which heat is generated by the electrical resistance of the charge or its container to the passage of currents induced electro-magnetically, is extensively and increasingly used in the heating and melting of non-ferrous metals. The choice of this method is often dictated by the savings made possible in labour, floor space, scale, die-life, etc., and the raising of productivity and often of quality arising from the rapid, uniform and controlled heating it can provide. Starting and stopping of heating are instantaneous. All these factors can, in many cases, effectively outweigh any fuel-cost savings estimated to be possible from using fuel-fired methods. In some applications induction heating provides the only practicable solution.

General Heating Processes — Induction heating can be applied effectively to a wide range of common non-ferrous metals, including aluminium, brass, bronze, copper, nickel alloys, etc., in extrusion, rolling, upsetting and similar processes. Its overall efficiency for this work is governed by the shape, size and material of the billet. Mains frequency induction heating is usually possible for such as copper, brass and aluminium billets if they are about 3 in. diameter or over.

Induction heating is also extensively used in soft and hard soldering and welding operations, particularly where high production rates are involved or where its ability to provide very rapid and very localized heating enables special applications to be carried out without difficulty.

A special application of induction heating which has come to the fore with the growth of the semi-conductor industry is in zone refining and crystal pulling, where it is effectively challenged only by another and newer electrical method, electron bombardment, which will be discussed later.

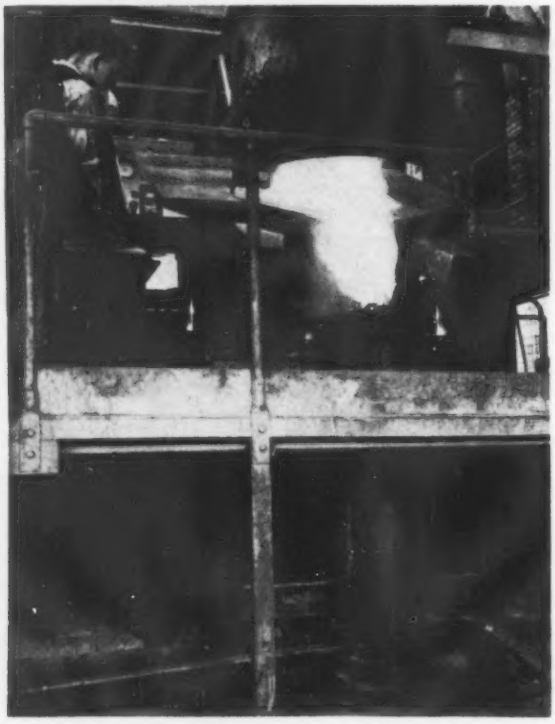
In crystal pulling, an induction coil external to a quartz tube provides heat to a graphite susceptor holding a crucible containing the pure metal. The quartz tube can be evacuated and/or gas filled and is water-cooled. A somewhat similar arrangement applies in zone refining, where the external coil heats directly a narrow zone of the metal in rod form, held vertically between two chucks, the coil and hence the molten zone moving upwards at a precise rate. Electronic controls are extensively used in these equipments to provide accurate regulation of all necessary factors.

Generally speaking, induction heating for non-melting applications is steadily extending its range of activities rather than undergoing any spectacular new development.

Melting—There has been a marked progress in the use of induction melting equipment in non-ferrous foundries arising from the advantages of clean working conditions, reduced floor space, rapid melting, accurate control, reduced metal loss, oxidation and gas pick-up, and the induced stirring effect so useful in alloying.

The submerged channel core-type mains frequency induction furnace has been extensively used for many years in melting brasses for billet and slab casting, as well as for the zinc and aluminium alloys (Fig. 1). The use of this type of furnace by Wolverhampton Diecasting Co. Ltd., where zinc alloys are conveyed from the melting furnaces to the die-casting machines through electric resistance - heated launders, is of special interest (Fig. 2). Channel type furnaces are available with air-operated controlled discharge units for aluminium and zinc alloy die-casting.

Also showing considerable progress over the last 20 or 30 years is the high frequency coreless furnace, available generally now as tilting and lift-coil types, which is enjoying especially



[Courtesy: Serck Tubes Ltd.

Fig. 1 — Metalectric standard type mains frequency channel furnace, 700 lb, 100 kW

Fuel economies, maintenance costs and demands on floor space all compel manufacturers to consider thoroughly the relative merits of various types of equipment before embarking on installations. This article outlines some of the merits of electricity in the melting and treatment of non-ferrous metals, and reviews the equipment currently in use, together with some of the more promising recent developments

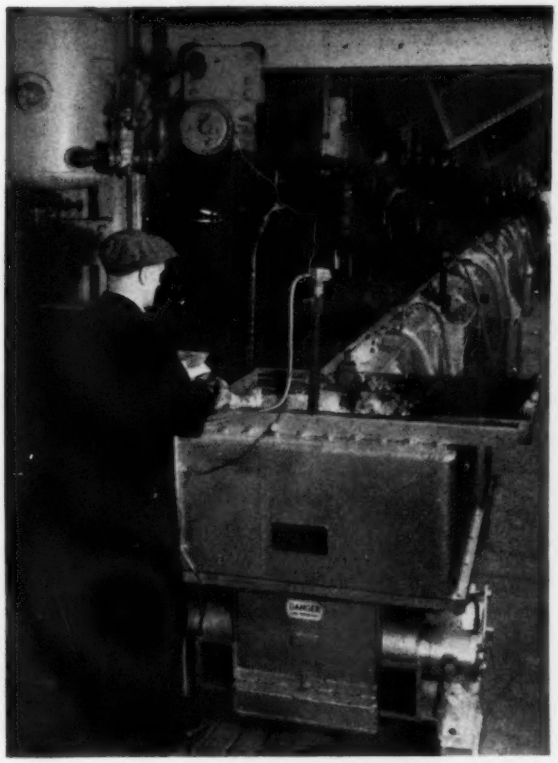


Fig. 2—A Birlec-Efco zinc alloy die-casting installation in which molten metal from two channel induction melting units is distributed to a battery of eight holding furnaces serving individual die-casting machines. Electrically heated launders connect the melting and holding furnaces

increasing use in melting special and high-melting point alloys.

The newcomer to this field is the mains-frequency coreless induction furnace which represents a major development in melting equipment and is extremely useful both for alloying and for economical bulk melting. As it embodies no essentially new principles, its commercial success over the last eight or nine years can be attributed mainly to careful attention to its design and the development of reliable and economical phase-balancing equipment and power-factor correction capacitors. There is a lower limit on size of furnace and the charge for cold starting, but these factors have not prevented its progress. It is very useful for melting borings and chips.

A mains-frequency coreless induction holding furnace, as developed by Wild-Barfield Limited, uses a plumbago-lined cast iron pot to contain aluminium and its alloys for die-casting. It can be used as a general purpose furnace of the bale-out or tilting type but can also be fitted with a controlled discharge unit for low pressure die-casting, its throat being induction heated to maintain the metal in the connecting tube at correct temperature. The furnace has an air-cooled coil and maintenance is very low. Fig. 3 shows these holding furnaces in use at Alumasc Limited, Burton Latimer.

Induction furnaces are generally low in running costs, often lower than those associated with fuel-fired furnaces and certainly so when factors other than the cost of fuel per lb. of metal are taken into account. Their capital cost is, however, rather high and may for some time restrict their extensive use to the medium and larger foundries. They are bound to be increasingly considered as foundry processes move towards partial or complete automatic working.

Indirect Resistance Heating

This is the one electrical method which is directly comparable with the fuel-fired processes in that it depends on the generation of heat outside the charge and its transfer to that charge by

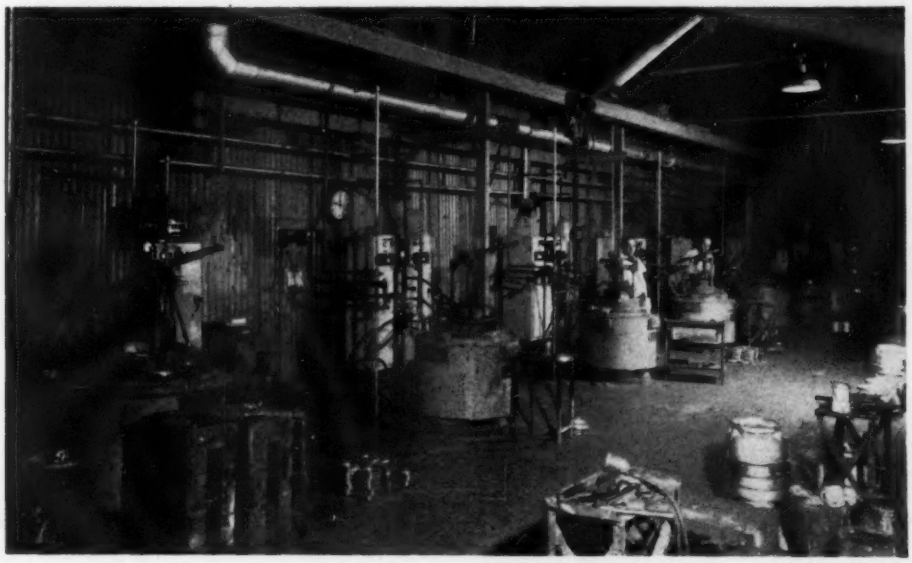
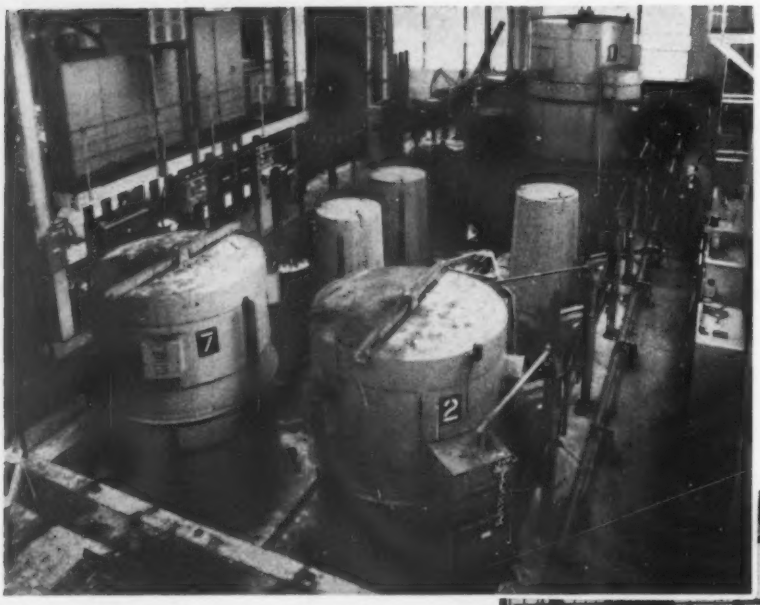


Fig. 3—Wild-Barfield mains frequency, coreless induction, aluminium holding furnaces



Above: Fig. 4—Efco bell furnaces for the bright annealing of copper wire

Right: Fig. 5—Metalectric pit type furnaces for heat-treatment of aluminium alloys

[Courtesy: Garrington's Ltd.

normal heat transfer processes. The inherent differences involved are that with electricity heat generation is always 100 per cent efficient, irrespective of the age or condition of the heater or the proportion of full load called for by the control system, and that there is a complete absence of combustion and its products. Electric furnaces invariably have lower heat losses than their fuel-fired counterparts, and are usually more easily fitted into a completely or partly automatic production line. They provide minimum disturbance of the working environment.

General Heat-Treatment Processes—Electric furnaces are produced for batch or continuous operation with charging and conveying arrangements generally in line with those offered by the fuel industries and for similar general heat-treatment processes (vacuum treatments will be discussed later).

Recent batch furnace installations include one of four furnaces commissioned at Earle, Bourne and Co. Ltd. by G.W.B. Furnaces Ltd. for annealing brass strip, each furnace rated at 342 kW in three zones and with hearth dimensions of 20 ft × 5 ft. The installation includes a turntable charging machine and five loading tables. Maximum design temperature is 750°C., two of the furnaces being fitted with a reduced input control system to allow lower temperatures, as for stress-relieving, to be carried out without impairing temperature uniformity, which is assisted by five independently driven waffler type air fans in the roof of each furnace. The furnaces have been operating for 24 hr/day, their control systems having safety contacts to cut off the electricity supply in the event of accidental overheating.

Leeds and Northrup Ltd. have recently fitted a cooling blower to their steam Homo tempering furnace to accelerate furnace cooling on a production basis. This new furnace is primarily intended for stress-relieving, age-hardening or annealing non-ferrous parts, particularly copper or high-copper alloys, in a steam atmosphere so that they are ready for immediate use or for plating without further cleaning treatment. It is of the vertical loading type with an inner metal retort for the steam atmosphere, which can be adapted for other controlled atmospheres when necessary. Rapid cooling can be effected at the end of the heating cycles with the parts still sealed in the steam or other atmosphere.

There has been considerable activity in bell and pit type furnaces, which are so well suited to electric heating and are widely used for such applications as the bright annealing of non-ferrous wires and similar products. A typical bell furnace installation by Efco Ltd. for the bright annealing of copper wires is shown in Fig. 4. Careful design of the heating zones aided by forced circulation of the controlled atmosphere by powerful fans in the bases ensure close temperature uniformity throughout this type of furnace. Pit type furnaces are illustrated in Fig. 5, showing an installation of ten such furnaces by Metalectric Furnaces Ltd. and used by Garringtons Ltd. for the heat-treatment of aluminium alloys. Each furnace has internal basket dimensions of 32 in. dia. by 32 in. deep and is rated at 30 kW.

Annealing in an inert atmosphere to prevent the staining of aluminium stock is the purpose of two furnaces recently supplied by Stordy Engineering Ltd. to a large aluminium works in Canada, which have enabled a stringent specification to be more than satisfied. Each furnace is rated at 900 kW, suitably divided into separately-switched banks for close temperature control with fast heating-up rates, and can handle 40,000 lb. of aluminium per charge, charging being carried out by a three-arm charging machine on to a hearth which is free of refractories and hence avoids dust contamination of the atmosphere. The motorized, counter-balanced door has water-cooled sealing arrangements.

Turning to furnaces of the continuous type, an interesting example is a small furnace developed by Royce Electric Furnaces Ltd. for preheating non-ferrous slugs up to 1 in. dia × 1 in. lg. for press work. Output is 50 lb/hr.,

temperatures up to 900°C., but a tapped transformer is used to provide appropriate supplies for reduced outputs down to about 16 lb/hr. The slugs are heated in three parallel tubes and the synchronous pusher gear is arranged to discharge the hot slugs in rapid succession but consecutively from the three tubes. The slugs are loaded into a magazine at the entry end, and the furnace can proceed automatically without manual attention for long periods (Fig. 6).

A flash annealing furnace taking aluminium alloy sheet up to 8 ft. wide and supplied by G.W.B. Furnaces to Birmetals Ltd. has four working zones totalling 600 kW and eight fan units which, with a system of air-directing baffles, ensure maximum uniformity of heating across the width. The heating chamber length is 40 ft., followed by a 70 ft. cooling chamber, and the furnace has provided throughputs of more than 2 tons/hr. of uniformly treated fine grain sheet eminently suitable for pressing.

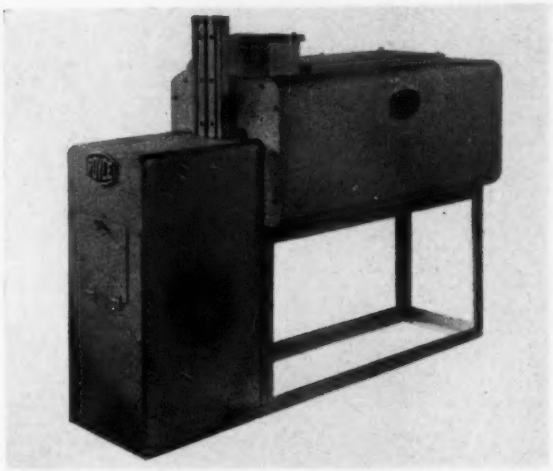
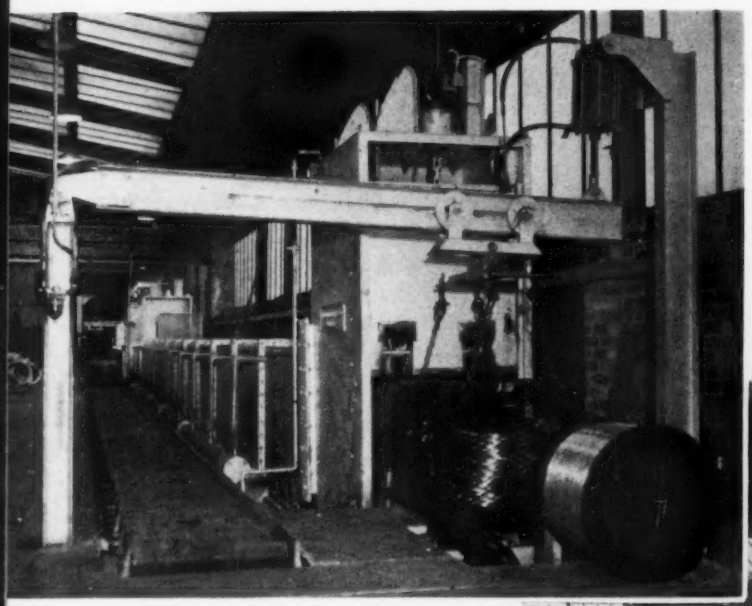


Fig. 6—Royce continuous slug heating furnace

A variation to the bell furnace for bright annealing copper wire is the continuous furnace shown in Fig. 7 and supplied by Metalectric to W. T. Glover and Co. Ltd. This furnace, rated at 135 kW, has an output of 144 tons/week of wire, on spools or coiled, annealed in an exothermic atmosphere at a consumption of 58 kWh/ton.

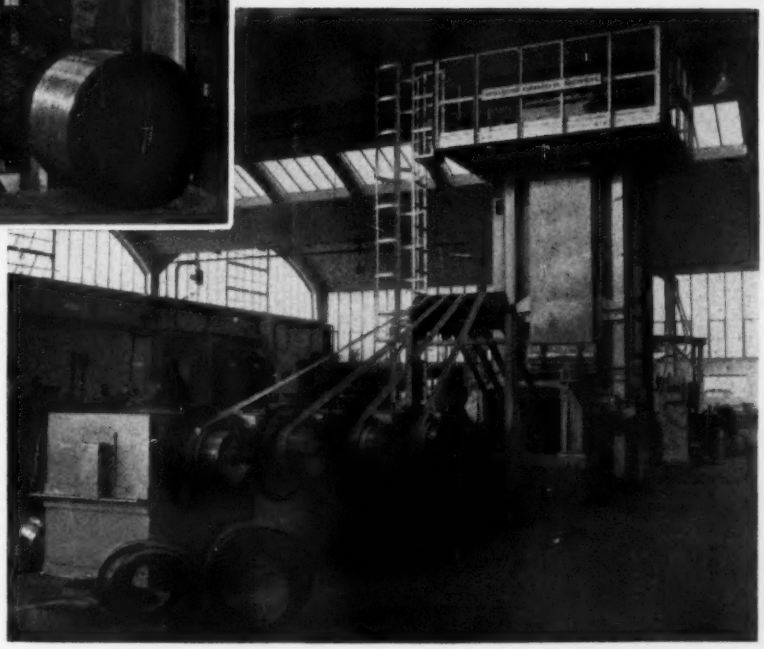
A Metalectric tower type furnace for continuous annealing of beryllium copper and special alloy strip at Telegraph Construction and Maintenance Co. Ltd. is shown in Fig. 8. A roller hearth furnace by the same supplier, which provides interstage annealing of non-ferrous tubes at John Everitts Ltd., is 147 ft. long, handles 3 tons of tubes per hour and employs the spray quench technique to reduce the length required for cooling.

(To be continued)



[*Courtesy: W. T. Glover & Co. Ltd.*

Above: Fig. 7—Metalectric continuous furnace for bright annealing copper wire on spools or in coils. Output 144 tons per week



[*Courtesy: Telegraph Construction and Maintenance Co. Ltd.*

Right: Fig. 8—Tower type continuous strip annealing furnace, by Metalectric Furnaces Ltd.

Corrosion

SECOND TECHNICAL SESSION AT THE INSTITUTE OF METALS AUTUMN MEETING

(*Concluded from* METAL INDUSTRY, 13 *October* 1961)

AT the Institute of Metals Autumn Meeting in Brussels, a number of speakers commented on the six Papers presented under the general heading of "Corrosion". A further selection of these comments appears here, concluding our report of the meeting.

Commenting on the Paper by C. Edeleanu, **H. S. Campbell** (British Non-Ferrous Metals Research Association) said since pits, when viewed on the macroscale were usually approximately hemispherical, he presumed that the rapid progress of pitting on very narrow fronts, as described in Edeleanu's Paper and shown in his film, ceases quite rapidly and is replaced by similar progress at some other point within the general area where pitting is taking place. Has Edeleanu any ideas as to why the microscale pitting stops so soon and (as it appears from the film) so suddenly restarts somewhere else?

Referring to the Paper by E. A. G. Liddiard and J. A. Whittaker, he said that Liddiard had referred to Fig. 4 in the Paper which showed the maximum depth of intercrystalline attack in HE10 exposed at Sheffield continuing to increase with time up to 6 yr., though the rate of loss of strength falls off appreciably after 4 yr. Was this apparently somewhat anomalous result merely due to there being no point on the curve for maximum depth of intercrystalline penetration after 4 yr.? The curve as drawn must be rather hypothetical between 1 and 6 yr. If the actual maximum depth of intercrystalline attack after 4 yr. was somewhat higher than indicated by the interpolated curve, the curves for maximum depth of intercrystalline attack and maximum loss of strength would be very similar. It was appreciated that it was, in fact, impossible to measure actual maximum depth of intercrystalline attack anyway, and that Fig. 4 could only represent the maximum depth of intercrystalline attack in the microsections examined.

Dealing with the corrosion of aluminium-magnesium-silicon and aluminium-copper alloys, **E. W. Skerrey** (British Aluminium Co. Ltd.) said that in Liddiard and Whittaker's Paper the predicted equivalent losses of thickness based on loss of strength given in Table I were most encouraging. Judging by the flatness of the curves in Figs. 2 and 5, and their own work (METAL INDUSTRY, 1948, **72**, 440, 463; 1949, **74**, 7, 13), even some of these values might include a safety factor, e.g. comparing the flatness of the curves in Fig. 5 with column (a) of Table I. On p. 425, the authors found a significant effect of stress on the corrosion rate of HE10 under constant strain testing under atmospheric conditions, and said that results might be less favourable under constant load. No values were given, however, to permit the reader to form his own assessment of the validity of these views. In these circumstances, it seemed reasonable to

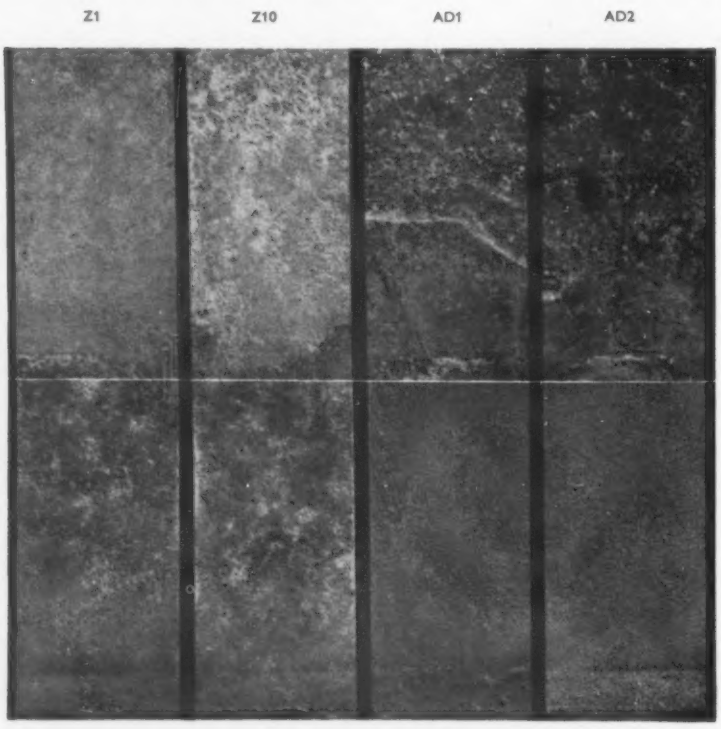


Fig. 1—Sprayed aluminium coatings on D.T.D.683, seven and a half years' exposure in salt spray

Z1—S.P. aluminium–1 per cent zinc alloy coating, powder method 3·1 mils

Z10—S.P. aluminium–1 per cent zinc alloy coating, powder method 3·0 mils.

AD1, AD2—Uncoated controls

X1—Aluminium–1 per cent zinc alloy coating, wire method, 4·5 mils

X9—Aluminium–1 per cent zinc alloy coating, wire method, 4·1 mils

Y4—99·5 per cent aluminium coating, wire method, 3·1 mils

Y5—99·5 per cent aluminium coating, wire method, 3·5 mils

accept the more convincing evidence on page 427, where the authors themselves concluded that there was no stress-corrosion hazard with HE10 when directly assessed by constant-load testing in salt spray. Moreover, these latter results were in line with general experience.

In general, with pure aluminium and binary aluminium alloys, there was some correlation between loss of elongation or ductility and intercrystalline corrosion. However, with the aluminium-magnesium-silicon alloys, this relationship was more difficult to find, as noted by the authors on p. 425.

This feature appeared to be shared by the H10, 20 and 30 series, e.g. intercrystalline attack to a depth of 13 mils on H20, and to a depth of 7 mils on H30 without any significant loss of T.S., proof or elongation, had been observed.

It may not be permissible to dismiss intercrystalline attack as of relatively minor importance when it becomes extensive, and it would be interesting to have the views of the meeting on any physical factors that could be seriously affected by intercrystalline corrosion in the H10, 20, 30 type alloys (aluminium-magnesium-silicon alloys).

The Paper by Liddiard, Whittaker and Farmery also indicated a similar state of affairs for HE10 where no significant effects were noticed in salt spray (p. 382) and for industrial tests, the loss in mechanical properties, as assessed by deflection, being less than expected from the intercrystalline attack. (Was this work that described for Sheffield and Euston in the other Paper?) Would it be reasonable to say that intercrystalline attack has only one-half to one-quarter the anticipated effect on mechanical properties for H10, and possibly even less for some aluminium-magnesium-silicon alloys?

Table I, p. 380, showed very dramatic reductions in the loss in effective thickness for as little as 6 hr. ageing at 190°C. for HE15, and this was of considerable practical importance, since, even when the metal was protected by metal spraying, the life of a protective system was affected by the resistance of the base material.

In the synopsis, p. 377, the authors say that stress corrosion in the short transverse direction was normally associated with layer corrosion. On p. 381, referring to Table II, and also in the conclusions, it was found that stress applied by constant strain bending does not significantly affect the rate of layer corrosion. Could the authors say whether the stress corrosion susceptibility in the short transverse direction can be countered by the same ageing treatment which reduced loss in thickness by layer corrosion, e.g. 6 hr. at 190°C.

From the Paper by Bell and Campbell, it was very gratifying to know that unsightly and damaging effects shown in Figs. 1 and 4 can be avoided by ageing for 24 hr. at 185°C. Nevertheless, the time required for the ageing treatment is rather lengthy, and hence costly. In three cases for commercial extrusions, A, L and D, p. 468-9, there was no exfoliation after the 10-15 hr. treatment at 175°C. One of the commercial extrusions appeared also to have a high resistance to stress corrosion in the short transverse direction. It is, therefore, not proven that more costly heat-treatment is generally justified.

While it has been shown in the other Papers that by suitable production procedure, including heat-treatment, layer corrosion can be avoided, it still remains necessary to protect high strength alloys when exposed to seriously corrosive environments. The Paper by Carter and Campbell added further evidence for the value of metal sprayed coatings for this purpose where rolled-on claddings were unsuitable. While this gave superior protection to painting, the two forms of protection together were to be preferred because of the excellent base which the sprayed metal coating provided for painting and because painting, with the minimum of maintenance, could ensure permanence of the sprayed metal protection.

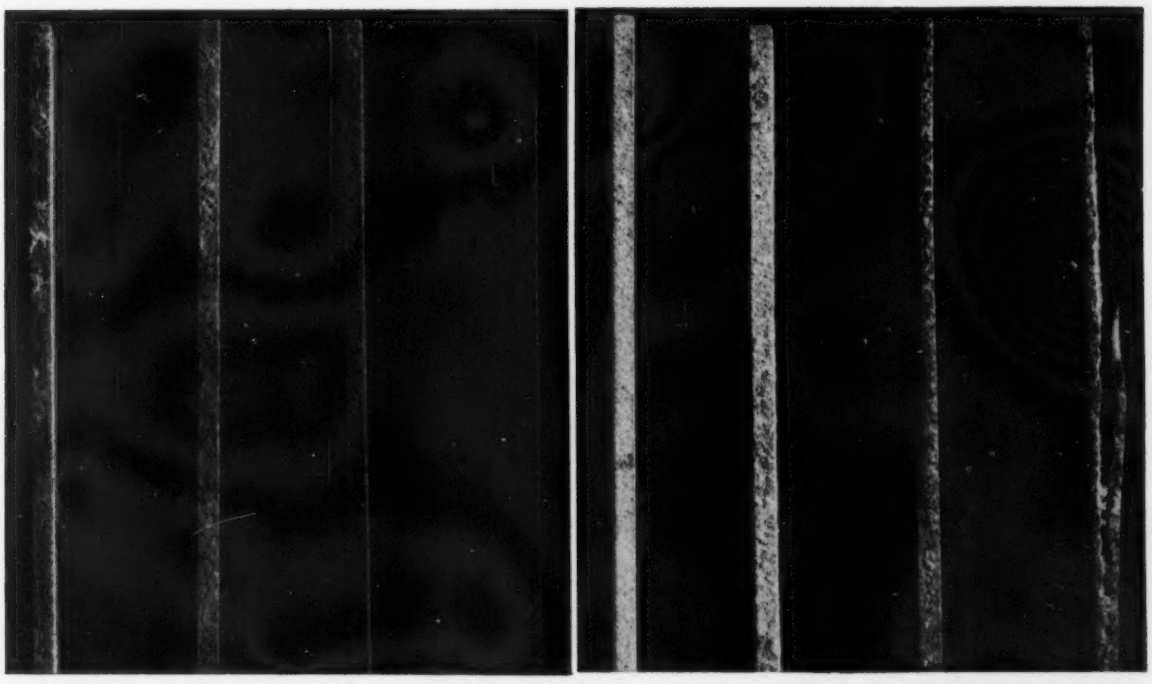
The very appreciable protective value of sprayed metal coatings as thin as 3 to 4 mils in D.T.D.683 extrusions—7½ years salt spray—is shown in Figs. 1-3.

An esturian bridge containing extruded H15 members, metal sprayed with aluminium and painted with a zinc chromate primer followed by aluminium pigmented undercoat and topcoat, is in excellent condition after service for about eight years; thus indicating the practical usefulness of this combined method of protection for this type of alloy.

Authors' Replies

Replying to the discussion of the Paper by himself and Miss W. A. Bell, and that by himself and by V. E. Carter, **H. S. Campbell** said Liddiard had drawn attention to the surprisingly low hardness value recorded in Table III for the higher copper extrusion aged for 72 hr. at 185°C. This was not a misprint but the actual hardness as measured, and there was apparently

Fig. 2—Edges of specimens, depicted opposite, of sprayed aluminium coatings on D.T.D.683 after seven and a half years exposure in salt spray



no explanation for it being so low in relation to the tensile strength of the material.

Pourbaix suggested the application of potentiostatic and potentiokinetic curves to investigating susceptibility to exfoliation corrosion. It seems a little doubtful whether this would be practicable. In the first place, exfoliation corrosion normally occurs under atmospheric exposure conditions, but not under immersed conditions. It is therefore probable that the local conditions which give rise to exfoliation would not be reproduced under totally immersed conditions such as would presumably be necessary for plotting polarization curves. This may not be an insuperable difficulty since it appeared from the contribution made by Gardam that it was possible to reproduce exfoliation corrosion in a controlled potential accelerated corrosion test with the specimen completely immersed. The conditions may, however, be rather difficult to establish.

In the second place, although exfoliation corrosion was prevented by extended ageing of HE15 alloy, this treatment did not suppress corrosion so much as change its form. Instead of attack taking place between relatively coarse bands, as in the normally aged material, it took place at the boundaries of a sub-grain structure. Would it not be very difficult to distinguish between these two forms of attack by purely electrochemical means?

Pourbaix also referred to the probable value of sprayed coatings for protection against stress corrosion. This has been under investigation for some years. The work is now nearing completion and should be published before very long, but the only published reference to it so far is a brief note in the *Journal of the Royal Aeronautical Society* (1961, **65**, 633) which deals with the importance of suitable surface preparation for metal spraying to prevent stress corrosion of high strength aluminium alloys. In general, the results of these experiments have been most encouraging, it having proved possible to protect even D.T.D.683 alloy stressed to 90 per cent of the proof stress in the short transverse direction of extrusions and forgings.

Milbourn's remarks on the differences between severity of corrosion at different sites being due possibly to differences in frequency of wetting and drying rather than to differences of total rainfall were made primarily with respect to Liddiard and Whittaker's Paper, but since the work of Rosenfeld, to which Milbourn is presumably referring, indicates that the most rapid corrosion takes place when the moisture film on specimens exposed to the atmosphere is extremely thin, daily wetting by dew is probably at least as important a factor as intermittent wetting by rain.

The slides shown by Gardam of specimens corroded under controlled potential conditions show remarkably good correlation with the results of humidity room and atmospheric exposure tests on the same materials. It appeared that this test might provide a reliable means of determining rapidly the susceptibility of samples of HE15 to exfoliation corrosion, but it seemed that the apparatus used was rather too specialized for general industrial application. Perhaps Gardam's colleagues can devise a means of carrying out the test by somewhat simpler means.

Replying to some of the points raised, **E. A. G. Liddiard** said Edeleanu had pointed out that his work had been done on super purity aluminium and this probably accounted for the pits being transgranular rather than intergranular, since solute elements tended to segregate at grain boundaries. Campbell queried whether the curves shown in Fig. 1 could fairly be drawn to cut the horizontal axis,, and my reply would be that this would be apparent if the results were plotted $D=K \log t$.

Regarding the question by Milbourn, who had asked if they had any experience of behaviour in service of manganese-free H10 alloys, there were several structures put up by their associate company, S.M.D.E., prior to 1955. These included the Dome of Discovery, a hangar at London Airport, and the telescopic gangways at Southampton. The latter and several other minor structures had been examined from time to time and no significant deterioration in strength had been found. Milbourn also raised the question of correlation with the A.S.T.M. tests. He would have liked to be sure that differences were not due to differences in the U.S. and U.K. alloys. The A.D.A. were taking steps to have comparable tests on the same materials done both in this country and in the U.S.A. The preliminary results after one year's exposure amply confirmed the higher corrosion rate in this country.

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Large gross samples may be subdivided down to about 25 litres by the method of halving, coning and quartering, although correctly designed mechanical subdividers are preferable, being faster and more accurate. Both methods are described in the standard, the mechanical dividers being of the turntable and slotted cone types. For further reduction, oscillating hopper dividers are described and a divider of the grid type. The smaller of the oscillating hopper dividers will reduce the gross sample to 0·2 mL., which is an appropriate quantity for size analysis by sedimentation or elutriation. Methods of reducing this sample to the milligramme or less required for microscope analysis will be described in the part of the standard to be devoted to such analyses. The overlap of the quantities for which each process is suitable provides a measure of flexibility in the conduct of a subdivision.

Copies of the above-mentioned standards may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

OUT OF THE MELTING POT

Fluoride Castings

SOME out-of-the-usual foundry problems were encountered in the development of a technique for melting and casting calcium fluoride-magnesium fluoride "alloys" to produce parts for applications utilizing the high corrosion resistance of these compositions. To begin with, there was the problem of finding a suitable crucible material capable of containing these extremely aggressive fluoride melts at temperatures of about 1,000°-1,300°C. In this connection, silica, alumina and other oxide impurities picked up from refractories were found to increase the tendency, quite troublesome in itself, of the fluoride alloys to crack during solidification. Crucibles machined from electrode graphite proved to be the most satisfactory. Another problem—analogous to that encountered in metal foundry practice—was gas porosity of the cast fluoride alloys, arising from moisture present in the constituent magnesium fluoride and calcium fluoride and in the crucible. The trouble could be cured by double melting in carefully dried and preheated graphite crucibles and, if necessary, by blowing the melt with dry air or oxygen. As for melting, the problem of mould reaction was solved by using graphite for the permanent moulds and cores and a mixture of ground clay-bonded crucible scrap, 8-10 per cent water and 3-5 per cent fireclay for temporary moulds and cores. The moulds have to be dried and preheated to 750°-850°C. in order to ensure slow (furnace) cooling, which, in the case of castings weighing 0·5 to 20 kg. and poured at 1,050°-1,100°C., should be about 30°-50°C/hr. As regards composition, the best results were obtained with the eutectic alloy (52 per cent calcium fluoride-48 per cent magnesium fluoride, melting point 970°C.). This alloy in the cast state has an ultimate tensile strength of 4,612 kg/cm^2 and an ultimate bend strength of 518 kg/cm^2. Its thermal shock resistance can be improved by the addition of 2-5 per cent of nickel fluoride. Sound castings can only be obtained by using starting materials of high purity. A particular example of fluoride alloy castings is tubes 60 mm. diameter, 5 mm. wall thickness and 300-400 mm. in length.

A Collective

DID the Greeks have a word for it? For the sum total of wear and tear, corrosion, and all the other factors that combine to contribute to the ultimate demise of manufactured metal products? If there is nothing to borrow from the Greeks, an appropriate word should certainly be coined. Its existence could help a great deal in correcting in due course the present situation in which the wood, to which the new word would apply, cannot be seen for the trees—friction, wear, corrosion and all the rest of them. And it is not only just a matter of failing to see. There is also the consequent failure to investigate, understand, appreciate and, if possible, cope with the matter as a whole. Severally, friction, wear, corrosion and their constituent phenomena have been investigated and are still being investigated in detail. Theories have been advanced to provide detailed explanations of friction, of wear, and of the various forms of corrosion. Unfortunately, except in laboratory tests, the various phenomena rarely occur in isolation, and it is at least arguable that detailed studies of them individually are inimical to an appreciation of them collectively. So far, collectivization has not progressed beyond such combinations as fretting corrosion, abrasive wear, corrosion fatigue, stress corrosion and similar binary systems. Beyond them, there is little understanding of the law governing the formation of more complicated combinations: it is certainly not a matter of simple addition. Thus, even if all the facts regarding the details are discovered, they could not be added up to give the complete answer. A study of (whatever the word may be) as a whole, is required before a successful synthesis from the elements can be attempted with a reasonable hope of reproducing the original.

Solid-Liquid Strength

A PAPER to be presented at the Fall Meeting of the Metallurgical Society of A.I.M.E. provides an encouraging, though as yet, alas, only a very much isolated, bit of evidence of interest in that largely unexplored region occupied by metallic compositions between the solid and the liquid states, i.e. compositions comprising either a solid phase in a liquid matrix or a liquid phase in a solid matrix. The particular Paper, only an abstract of which has appeared so far, relates to an example of the former—silver-alumina composites above the melting point of silver (960°C.)—and deals more particularly with their strength and creep behaviour. Certain silver-alumina composites show mechanical strength up to and beyond 960°C., the melting point of silver, which is the continuous phase in these materials. Specimens of such materials containing 15 and 20 per cent by weight of alumina were pulled to fracture in air at temperatures above 960°C. The average strength was found to be constant with temperature, being $3{\cdot}8 \times 10^6$ and $0{\cdot}4 \times 10^6$ dynes/cm^2 for materials containing 20 and 15 per cent alumina respectively. The creep behaviour of the 20 per cent alumina material was studied by allowing a rectangular bar to deform in bending under its own weight and under additional loads. The specimens always deformed for a given length of time and then appeared to cease deforming. Interestingly enough, the creep behaviour was very similar to that of solid metals. The activation energy of the process was determined to be of the order of 1·7 to 2·1 eV. Another interesting phenomenon was observed upon cooling these composite materials through the melting point of the silver, when it was found that single crystals of the silver matrix appeared to grow relatively easily, even though little care had been taken to ensure a suitable temperature gradient. For the immediate future it is proposed to undertake a study of slip line formation in these crystals.

Steinmetz

no explanation for it being so low in relation to the tensile strength of the material.

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SOME out-of-the-usual foundry problems were encountered in the development of a technique for melting and casting calcium fluoride-magnesium fluoride "alloys" to produce parts for applications utilizing the high corrosion resistance of these compositions. To begin with, there was the problem of finding a suitable crucible material capable of containing these extremely aggressive fluoride melts at temperatures of about 1,000°-1,300°C. In this connection, silica, alumina and other oxide impurities picked up from refractories were found to increase the tendency, quite troublesome in itself, of the fluoride alloys to crack during solidification. Crucibles machined from electrode graphite proved to be the most satisfactory. Another problem—analogous to that encountered in metal foundry practice—was gas porosity of the cast fluoride alloys, arising from moisture present in the constituent magnesium fluoride and calcium fluoride and in the crucible. The trouble could be cured by double melting in carefully dried and preheated graphite crucibles and, if necessary, by blowing the melt with dry air or oxygen. As for melting, the problem of mould reaction was solved by using graphite for the permanent moulds and cores and a mixture of ground clay-bonded crucible scrap, 8-10 per cent water and 3-5 per cent fireclay for temporary moulds and cores. The moulds have to be dried and preheated to 750°-850°C. in order to ensure slow (furnace) cooling, which, in the case of castings weighing 0·5 to 20 kg. and poured at 1,050°-1,100°C., should be about 30°-50°C/hr. As regards composition, the best results were obtained with the eutectic alloy (52 per cent calcium fluoride-48 per cent magnesium fluoride, melting point 970°C.). This alloy in the cast state has an ultimate tensile strength of 4,612 kg/cm^2 and an ultimate bend strength of 518 kg/cm^2. Its thermal shock resistance can be improved by the addition of 2-5 per cent of nickel fluoride. Sound castings can only be obtained by using starting materials of high purity. A particular example of fluoride alloy castings is tubes 60 mm. diameter, 5 mm. wall thickness and 300-400 mm. in length.

A Collective

DID the Greeks have a word for it? For the sum total of wear and tear, corrosion, and all the other factors that combine to contribute to the ultimate demise of manufactured metal products? If there is nothing to borrow from the Greeks, an appropriate word should certainly be coined. Its existence could help a great deal in correcting in due course the present situation in which the wood, to which the new word would apply, cannot be seen for the trees—friction, wear, corrosion and all the rest of them. And it is not only just a matter of failing to see. There is also the consequent failure to investigate, understand, appreciate and, if possible, cope with the matter as a whole. Severally, friction, wear, corrosion and their constituent phenomena have been investigated and are still being investigated in detail. Theories have been advanced to provide detailed explanations of friction, of wear, and of the various forms of corrosion. Unfortunately, except in laboratory tests, the various phenomena rarely occur in isolation, and it is at least arguable that detailed studies of them individually are inimical to an appreciation of them collectively. So far, collectivization has not progressed beyond such combinations as fretting corrosion, abrasive wear, corrosion fatigue, stress corrosion and similar binary systems. Beyond them, there is little understanding of the law governing the formation of more complicated combinations: it is certainly not a matter of simple addition. Thus, even if all the facts regarding the details are discovered, they could not be added up to give the complete answer. A study of (whatever the word may be) as a whole, is required before a successful synthesis from the elements can be attempted with a reasonable hope of reproducing the original.

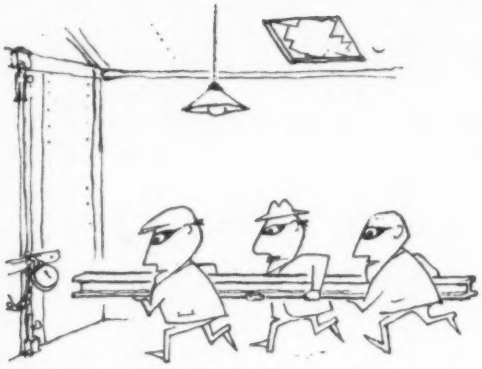
Solid-Liquid Strength

A PAPER to be presented at the Fall Meeting of the Metallurgical Society of A.I.M.E. provides an encouraging, though as yet, alas, only a very much isolated, bit of evidence of interest in that largely unexplored region occupied by metallic compositions between the solid and the liquid states, i.e. compositions comprising either a solid phase in a liquid matrix or a liquid phase in a solid matrix. The particular Paper, only an abstract of which has appeared so far, relates to an example of the former—silver-alumina composites above the melting point of silver (960°C.)—and deals more particularly with their strength and creep behaviour. Certain silver-alumina composites show mechanical strength up to and beyond 960°C., the melting point of silver, which is the continuous phase in these materials. Specimens of such materials containing 15 and 20 per cent by weight of alumina were pulled to fracture in air at temperatures above 960°C. The average strength was found to be constant with temperature, being $3{\cdot}8 \times 10^6$ and $0{\cdot}4 \times 10^6$ dynes/cm^2 for materials containing 20 and 15 per cent alumina respectively. The creep behaviour of the 20 per cent alumina material was studied by allowing a rectangular bar to deform in bending under its own weight and under additional loads. The specimens always deformed for a given length of time and then appeared to cease deforming. Interestingly enough, the creep behaviour was very similar to that of solid metals. The activation energy of the process was determined to be of the order of 1·7 to 2·1 eV. Another interesting phenomenon was observed upon cooling these composite materials through the melting point of the silver, when it was found that single crystals of the silver matrix appeared to grow relatively easily, even though little care had been taken to ensure a suitable temperature gradient. For the immediate future it is proposed to undertake a study of slip line formation in these crystals.

Skimmer

Ever since Cain killed Abel crime has been news, and in these modern days crime and punishment remain among the most newsworthy of topics. Many people believe that crime, like winning the football pools, always happens to somebody else but, with the ever-increasing number of offences, the odds on you being directly affected by a crime are reducing daily. It is wrong to take the view that there is nothing the public can do about it, and in this article a few practical steps the metal trade can take to safeguard its property are described.

Protect Your Premises



". . . . Doors should, therefore, be protected from attack both from without and within . . . ."

PREVENTIVE measures taken in time, and before the event, have far-reaching effects on the incidence of crimes of theft, and if the owners of premises would adopt really sound measures it might well have the effect of preventing crime troubling them at all.

Immediately after the last war, when non-ferrous metals, and particularly nickel anodes, were at a premium, many gangs of metal thieves, some clever and some not so clever, sprang up throughout the country and for a time made a very lucrative profit.

To combat them, a special squad of detectives was set up in Birmingham and the Midlands, one of its main aims being to smash up these gangs. The squad was extremely successful in its operations, and within a comparatively short time metal became "too hot" for thieves to handle.

Whilst there are by no means as many metal thefts committed as in the "bad old days", far too many are still being carried out and in many cases it must be said that the owners were almost asking for trouble because of the appalling lack of security in their premises.

It is only common sense that really valuable property should be properly safeguarded, but it is surprising how many people who have the care of valuables, whether it be in the form of money, jewellery, or metal, fail to take reasonable and sensible precautions. It may well be a case of familiarity breeding contempt.

To make sure that all is being done that can be done, it might be worth while for those concerned to take a searching look at their own security arrangements to see whether anything can be done to improve them. The job should be done systematically, starting with the perimeter fence and then going gradually through the buildings, not forgetting the cellar and the roof.

The best means of fastening outside gates is to fit a close shackle padlock of good quality, but it is no good having a good padlock if the padlock bar is of poor quality. Manufacturers of better quality locks usually supply a padlock and padlock bar fitting complete.

Entrance doors should be checked to ensure that they are fitted with good quality five lever mortice deadlocks. Double entrance doors are best secured in the same way as outside gates. Other external doors should be examined to see that they are strong enough to resist attack. Solid doors are by far the best, and apart from fitting quality locks it is a good idea to install bolts on the inside to give added strength against violence from the outside.

Doors with glass panels need the same sort of fastenings but some protection should be given to the glass. This can be achieved by fitting a substantial metal grille.

". . . . Cellar gratings and cellar flaps are frequently used to gain entrance to premises."

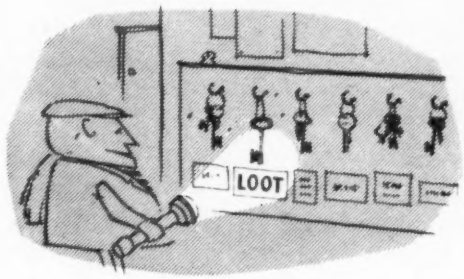
It is generally believed that if doors are safe from attack from the outside they are adequate, but this is not the case. If entry is gained to premises by a fanlight, a window or the roof, it is a simple job to open doors from the inside and so facilitate the theft of large quantities of property from the premises. It has even been known for vehicles to be driven in and loaded up with stolen goods. Doors should, therefore, be protected from attack both from without and within.

Skylights and windows are particular problems and often require a great deal of protection. This protection can be achieved by utilizing grilles made of expanded metal which can either be permanent fixtures or fitted with quick release attachments, enabling them to be taken down during working hours. Steel protection bars are another method, but if they are used they should be made as a frame with the bars not more than 5 in. apart, the whole frame to be securely fastened into brickwork. They should not be fixed with screws because all that is needed to remove them is a screwdriver.

It is difficult to prevent criminals from reaching the roofs of premises, but it has been found that fitting a spiked umbrella arrangement to fall and stench pipes makes climbing a hazardous business.

Cellar gratings and cellar flaps are frequently used to gain entrance to premises. Make sure cellar openings are secured and if the grating is faulty replace it. If the cellar is no longer used, have the opening bricked up. Cellar head doors giving access to the remainder of the premises should be secured with strong locks.

A responsible member of the firm should be entrusted with the job of locking all doors and windows at the end of the day's business, to ensure that the job is properly done. Keys should be removed from the premises or locked away; a marked keyboard



". . . . a marked keyboard with labelled keys should never be displayed."

with labelled keys should never be displayed.

If the premises to be protected are large, the cost of putting into effect all these physical precautions may prove prohibitive. In such cases, the cheapest, and often the most effective, way of obtaining better protection is the fitting of a silent burglar alarm which warns the police and not the burglar.

There are many misconceptions about the cost of this type of apparatus, which is cheaper to install than is generally appreciated. There is nothing to be lost by asking a representative from an alarm company to call and give a quotation without obligation. The apparatus can be extremely useful in protecting against loss of stock, as well as avoiding inconvenience and upset to business routine which burglaries so often cause.

Several metal merchants' premises in Birmingham are fitted with this type of alarm equipment, which has proved to be very successful in preventing thefts as well as materially assisting the understaffed police force in their fight against crime.

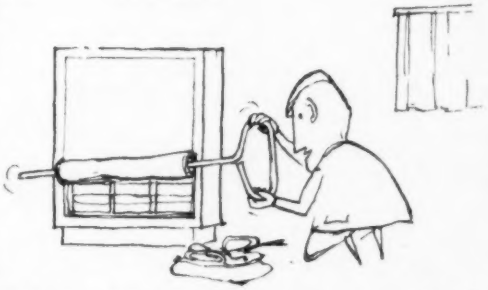
With the increase in the number of alarms fitted, the arrests brought about by them are rising steeply, particularly in the large industrial and business areas. Some idea of their success may be appreciated by the fact that in the six months ending 30th June, 1961, some 75 criminals were caught "red handed" in Birmingham alone.

The foregoing advice deals primarily with the protection of buildings and stock, but it is no good merely providing protection for stock at the expense of other things, particularly money and irreplaceable records.

There may be seen in many premises huge steel monuments to the safe-maker's art which have been handed down from generation to generation or bought second-hand in a sale. These safes invariably have sharp corners, which indicate that they are constructed of steel plates riveted together. There will be an imposingly strong front, but the sides and back will doubtless be wafer thin, making it child's play for an enthusiastic breaker to force open.

If one is unfortunate enough to be the owner of such a safe, it should be positioned in front of the window, where patrolling police officers can see it, with its back against a strong inner brick wall. The back and sides should be bricked or concreted in.

The outer case of a modern safe is moulded in one piece and has distinctive rounded corners. Moderately priced sates are now available which are almost proof against attack by drilling, explosives, or oxy-acetylene equipment. One word of warning, however; even a safe of this quality can be stolen if it is light enough to be manhandled by two or three men. Just to make sure, a safe weighing under half a ton should be bolted to the floor or bricked in.



"These safes invariably have sharp corners . . . . but the sides and back will doubtless be wafer thin . . . ."

Successful safe attacks reported in the press are invariably opened by drilling, explosives, oxy-acetylene or oxy-arc cutting, or by the simple expedient of removing the back. What is often lost sight of when reading these reports is that the majority of safes are still opened by the time honoured method of using the key, which, in many cases, is found by the thief "hidden" in a drawer cupboard, beneath a carpet, in the telephone tray, behind a picture, or ledged on the picture rail; in fact, in so-called "hiding places" too numerous to mention here but well known to criminals.

The advice relating to safe keys may be summarized as follows: do not leave the keys in the lock at any time; do not leave them on the premises when they are unoccupied; confine to as few as possible the number of employees who have access to or possession of safe keys.

Even if little or no money is kept in the safe, it is often that valuable records are housed in it for security against fire. Over the years, it has been found through bitter experience that businesses have been placed in jeopardy where records have been stolen when safes were removed from premises. If you have a safe—use it. If you have not, it is foolish to leave money lying about at any time. Use night safe facilities wherever possible.

Again, it is no good taking security precautions in this direction if your money is to be stolen on its way to or from the bank. If large amounts of money are either paid into or withdrawn from the bank, special precautions should be taken.

Every employer concerned with the movement of cash through the streets has a moral responsibility for the safety of employees delegated for the task.

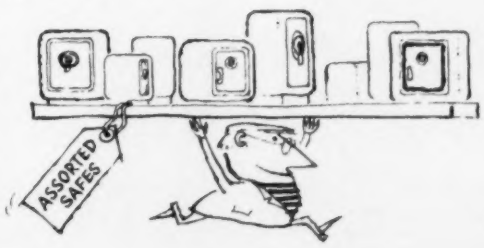
No amount of insurance can compensate for the feeling of reproach which must surely overcome any responsible person when, because of the lack of commonsense precautions, one or more of his servants is injured in a pay-roll attack. It cannot put right the disorganization and upset to routine which such an attack inevitably causes with its attendant feelings of panic and unrest. Variation of time and route, and the provision of adequate suitable personnel and transport are just a few points to bear in mind.

Another profitable avenue for thieves is the theft of vehicles and their loads. Insurance companies, because of adverse experience, are becoming more stringent in their security requirements for vehicles and loads.

To avoid a heavy increase in your insurance premiums it is in your interests to keep claims of this sort to a minimum. Do not let your drivers leave loaded vehicles in the streets or other places, where they can be easily stolen. Arrange for proper supervision and consider the fitting of immobilization devices. Various devices operating on either steering, gear-change mechanism, brakes, fuel supply, ignition, and transmission, are available.

Reverting to the special difficulties of the traders in metals, it would be well to mention three particular problems in crime with which they are faced.

". . . . a safe weighing under half a ton should be bolted to the floor or bricked in."



". . . . the provision of adequate suitable personnel and transport . . . ."

For some time now, a series of thefts has been carried out by audacious criminals who, after obtaining the confidence of a transport clearing house by safely delivering small loads, are directed to metal merchants' premises to pick up valuable loads of metal. No details of the driver and vehicle are taken and as often as not the load is never seen again.

If you are in the habit of employing contractors for the movement of your materials, please ensure that the driver of the lorry who comes for the metal is genuine. If you have even the slightest suspicion, a check should be made with the transport clearing house concerned.

Another type of confidence trick which is regularly practised is that of obtaining a sum of money in advance for a load of metal. In these cases, the "con-man" persuades his victim that he is in a position to obtain a load of metal at a very moderate price, but requires a deposit to clinch the deal. The deposit is given to the criminal, who is never seen again.

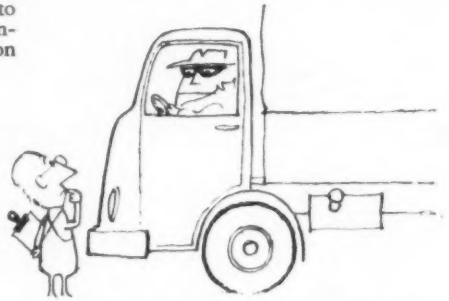
Larceny of scrap from metal dealers' premises is another problem which is always rearing its ugly head. Most dealers are familiar with the situation where lorries, usually operating under contract for the removal of waste, are allowed into premises and then, because of inadequate supervision, are loaded with scrap metal, which is then covered up with waste material and driven out unchecked. The easy way to overcome this type of crime is to provide proper supervision for contractors' vehicles when they are on your ground.

A difficulty which the police very often experience when criminals are caught with metal in their possession is to identify positively the owner. With scrap there is little that can be done, but now that anode thefts are again increasing, a little forethought can help the police a great deal.

New anodes received for storage should be marked on the shaft and in an inconspicuous place on the handle, preferably inside the hook. When the anode is placed in the vat the shaft markings soon disappear, but the marking on the handle remains, and if the police are enabled to make an arrest and recover property, their task of obtaining positive identification for the stolen anodes is eased.

All the advice given in this article is of general interest, but it may well be that a particular problem may arise in connection with particular premises. Most police forces will send along an officer to give advice if an approach is made to them. This is particularly so in relation to cash-in-transit.

This article paints a black picture about crime, and it behoves everyone to do what he can to bring a silver lining to the darkness. Do not take a negative or complacent attitude. Sensible action taken in good time helps considerably in the fight against the criminal. Do it today—tomorrow may be too late!



". . . . ensure that the driver of the lorry who comes for the metal is genuine."

MEN and Metals

News from the Staveley group is that **Sir Ben Lockspeiser** has been appointed to the board of Cyril Adams and Company. Sir Ben is scientific adviser to the group and is on the board of Staveley Industries.

The U.K. Atomic Energy Authority announce the appointment of **Mr. H. V. Disney,** C.B.E., M.I.Mech.E., at present deputy managing director, as managing director of their engineering group to succeed **Mr. J. B. W. Cunningham,** M.I.Mech.E., who is resigning as from January 20 next year.

At the October meeting of the Institute of Physics and the Physical Society the following were elected as Fellows of the Institute:—**E. Aruja, M. H. H. Bunton, B. H. Flowers, D. Greene, F. J. Grove, R. V. Hesketh, A. Jenkins, J. L. Lewis, C. G. McCue, J. A. McDonnell, A. F. Moodie, T. P. Newcomb, A. W. Pratt, D. H. Pringle, J. C. S. Richards, S. K. Stephenson, A. R. Stokes, R. Teale, W. F. Williams, P. D. Wilmot** and **N. R. Wynn.** In addition, 36 Associates were elected and 125 Graduates.

Formerly technical sales manager of Churchill Gear Machines Limited, **Mr. C. R. Tearne** has been appointed a director of this company. Other appointments made by the company are as follows: **Mr. W. Guss** to be technical sales manager; **Mr. T. Lewins,** chief machine tool designer, and **Mr. P. Wedgwood,** chief engineer.

A new director has been appointed to the board of George Salter and Company Limited to take charge of the company's manufacturing interests overseas. He is **Mr. G. P. Bache,** who has recently returned to this country from Australia, where he was, for nine years, managing director of the Salter spring balance and spring factories.

A Tube Investments subsidiary, New Conveyor Company Limited, of Smethwick, have a new managing director in **Mr. J. D. Dunlop,** M.C., B.A. Before joining New Conveyor, Mr. Dunlop was works director of J. J. Habershon and Sons, and previously with Armstrong Whitworth (Metal Industries) and Stewarts and Lloyds Limited.

Sales director of Thomas Marshall and Company (Loxley) Limited, refractory manufacturers, **Mr. W. T. Hale** has left on a tour of Canada, to visit customers in Montreal, Hamilton and Sault Ste. Marie, and later will join a tour, organized by the British Iron and Steel Institute, of iron and steel works, rolling and strip mills, and research centres, in Canada and the U.S.A.

The Brockhouse Organization has announced that **Mr. G. H. Woods** has been appointed sales and commercial manager of Thomas Chatwin and Company. He was formerly commercial manager of the B.S.A. small tools division.

Appointments announced by the Sheepbridge Engineering Group are those of **Mr. J. T. Davenport** as general manager of Sheepbridge Equipment Limited (Foundry Division), Chesterfield. **Mr. W. McLelland** will succeed Mr. Davenport as foundry manager of Sheepbridge Alloy Castings Limited.

Chairman and managing director of the Clyde Industries Group, **Mr. Raymond E. Purves** has joined the board of directors of the Fairey Company Limited, holding company for the Fairey group. Mr. Purves has been chairman and managing director of Fairey's Australian subsidiary company since it was formed in 1948.

Industrial News

Home and Overseas

Annual Dinner-Dance

Arrangements have been made for the seventh annual Birmingham area dinner-dance of the **Metal Finishing Association** to be held on Monday, November 27, in the Pavilion Suite, Warwickshire County Cricket Ground, Edgbaston Road, Birmingham, commencing at 7 p.m.

The cost of the tickets for this event is £1 15s. 0d., and applications should be made for these to Mr. P. Burns Farquhar, secretary, at 27 Frederick Street, Birmingham, 1, not later than November 10 next.

Metal Patterns

A very substantial repeat contract for high quality metal patterns and foundry tooling has recently been received by **International Patternmakers Ltd.** from a leading West German motor car manufacturer.

With its head office in Darlington, this company was formed in 1959 by a group of master craftsmen patternmaking firms in Birmingham, Darlington, Leamington, Leeds, Leicester and Manchester to develop the export of pattern equipment dies, foundry tooling and equipment, and is thought to be one of the largest organizations of its kind in the world.

Contracts have been successfully completed for foundries in Sweden, West Germany, Portugal, Switzerland, Yugoslavia and Israel, and the company is rapidly building up a world-wide connection in this branch of the foundry industry.

Aluminium in Building

At the forthcoming Building Exhibition, to be held at Olympia, London, next month, the uses of aluminium in building and architectural purposes will be amply demonstrated. On the stand of **Alcan Industries Limited,** for instance, prominence will be given to two new features on certain of the Noral aluminium building sheets: namely, a durable painted finish in a variety of colours, and a "sealed-end" effect that improves appearance and weathertightness.

The attractive painted finish, which will shortly be available, is a tough, baked-on vinyl coating which is permanent in colour and, due to a special anodic surface pretreatment (developed within the Alcan group of companies), will neither crack nor peel. It is on Noral Snaprib, also, that the sealed-end effect may well commend itself most to architects. Sealed-end Snaprib, in which the ends of the sheet are folded to form an integral eaves or ridge filler, or both, offers complete weathertightness at very shallow pitches; moreover, it presents even greater rigidity against wind load, and there is no questioning its better appearance, as can be seen from the installations in which it has already been used.

A newly developed sheet, Noral Wide-Pitch Industrial, will be shown for the first time, as will curved Noral Deep Trough Industrial, a 20 ft. length of which is incorporated to represent its use for barrel-vault roofing. A recent application of this, shown photographically, is the roof of the service reservoir for the Fylde Water Board at Weeton, Lancashire, covering nearly four acres.

Some prominence will be given to the range of miniature corrugated sheets, with illustrations of their use for interior panelling and decorative work, and embossed sheets in various patterns are also featured. The variety of Noral extruded sections supplied to the building industry for both structural and decorative purposes will also be seen in examples on display, including two panels of interlocking fascia sections and a 16 ft. length of handrailing incorporating strip-lighting in the top rail. The use of extrusions for curtain walling, patent glazing, window frames and decorative work is shown photographically.

Sections and sheet in certain alloys are also to be displayed in the range of anodized light-fast standard colours suitable for exterior use, and a selection from the immense number of lighter colours that can be used for interior decoration. Other Alcan products featured in the exhibition will include Noral high-purity aluminium for fully-supported roofing and flashing, treadplate, and aluminium paste as a pigment for paint.

Israel Copper Production

Blueprints for a 100 per cent increase in Israel's copper production from "King Solomon's Mines" at Timna, near Eilat, and for the addition of production facilities for blister copper, electrolytic copper and copper sulphate, have been worked out by the Timna copper works and approved by a foreign expert, it is learned from the Ministry of Development. The blueprint envisages an increase from the present annual rate of 6,700 metric tons (in terms of metallic copper) to 14,000 tons.

At the moment, the Timna plant produces only cement copper. The doubling of capacity will make feasible the production of electrolytic grade, and thus greatly increase the profitability of operations. The investment required is estimated by the works at $13,000,000, of which 45 per cent represents expenditure in foreign currency. It is not yet clear whether the company will try to carry out this expansion alone, or will enter into a partnership with foreign interests.

Rolling Mill Equipment

Extensions to the works of **W. H. A. Robertson and Company Ltd.,** of Bedford, which were held up in June last, are now being resumed, and it is expected that construction will now be completed by the end of 1962.

The project includes heavy machine and erection bays capable of handling weights up to 300 tons, thus placing Robertsons in an advantageous position for heavy plant manufacture.

Apprentice Training School

A new apprentice training school has recently been opened for **Thos. Firth and John Brown Limited.** The school contains a large workshop with facilities for training apprentice fitters and apprentice electricians in the basic skills of their trade, together with a comprehensive range of modern machine tools for the training of apprentice turners.

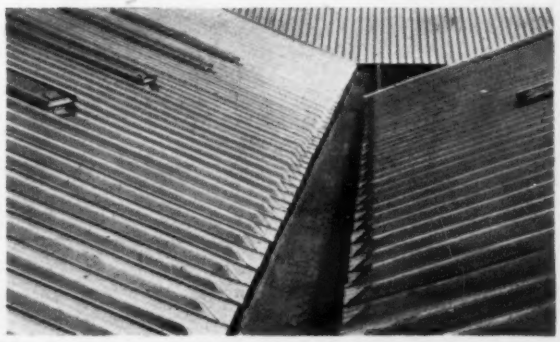
A lecture theatre equipped with visual aid equipment is provided for trade talks by the instructors and talks by invited speakers on specialized subjects. A feature of the school is the provision made for private study. In addition, the most up-to-date cloakroom and canteen facilities have been incorporated.

Under the guidance of a team of skilled instructors, the boys will probably spend eighteen months to two years in the school, and during the first few months they will be given an opportunity to work in each of the sections before moving to advanced training in one particular type of trade. They will then be taken, stage by stage, through the basic aspects of this trade until a satisfactory standard is reached; they can then be transferred to engineering departments, production machine shops or drawing offices for further training under other instructors and skilled craftsmen.

New Head Harness

It is a human weakness to throw off some piece of personal safety equipment because it is uncomfortable and either impedes vision or causes a headache or stiff neck in the effort to keep it on and still do the job in hand. Manufacturers of personal safety equipment are constantly striving to increase the comfort and ease of wearing such equipment, and **Safety Products Ltd.** now introduce a new conception in head harness for their hard hats.

This new head harness consists of a moulded polythene spider cradle fitting



This close-up view of one of the first industrial installations of Noral sealed-end Snaprib sheet, supplied by Alcan Industries Limited, shows the 'sealed-end' effect at the eaves.

over the head, the end of each leg having an adjusting device consisting of a nylon stud which can be moved up and down in a "holed" slot in the final part of the "leg" that is attached to the hat. Thus, instead of a "general" adjustment by draw string, this individual "leg" adjustment allows for the varying contours and shapes of individual heads. Adjustment for circumference of the head is carried out by two nylon studs fitting into a series of two parallel lines of holes on each side of the band and it also enables the hat to be worn in a headsling style if desired, thus eliminating the necessity for a chin strap, except in unusual or gale conditions. This headsling style is not only more secure but often more comfortable for certain shapes of head.

Three interesting features of this head harness are that a soft foam plastics plate is incorporated inside the top of the cradle, eliminating the discomfort that many users having bald tops experience when wearing safety hats. There is an unalterable safety head clearance in excess of 1 in. and a replaceable buffer band which is quite separate from the harness, providing proper protection at the back of the hat when worn headsling style. The sweatband, which consists of a self-adhesive soft plastics foam strip, is easily renewed, and the polythene head harness may be readily cleaned and sterilized for re-issue.

More than fulfilling the B.S. requirements, there are no metal parts either in the hat or harness, thus providing the ideal safety hat for use not only in the electrical field but almost every walk of life and work where head protection is advisable.

New Football Stand

Secretary of the Football Association, Sir Stanley Rous recently officially opened the new cantilever stand of the Sheffield Wednesday Club, which will seat some 10,000 spectators. A special feature of this new stand is the vast area of aluminium roofing carried by the steel framework.

The aluminium decking was installed by the Sheffield firm of Kelsey Roofing Industries Ltd., in Rigidal 20 gauge LT5, 6 and 7, plain-finish aluminium sheet supplied by **The British Aluminium Company Ltd.** The length of the stand is 360 ft., dimensions from back to front being 125 ft., thus there are nearly 45,000 ft^2 of aluminium in the roof, the weight of metal involved being about 17 tons. From ground to roof it is 80 ft. high.

Materials and Design

One of the exhibitors at the Engineering Materials and Design Exhibition, to be held at Earls Court, London, next month, is the firm of **Dewrance and Company Ltd.** On their stand, hard-facing with "Endewrance" alloys will be demonstrated; in this process, a layer of alloyed metal is deposited, either to surfaces, whether of mild or alloyed steel, or to the edges and points of machinery and equipment that may be exposed to various forms of wear. Both the rod and the T.L.B. powder process will be shown.

High temperature brazing is also to be demonstrated. Exhibits will portray the story of castings from the initial design stages through the foundry processes to the finished product. The castings on show will include such high alloy castings as chromium-cobalt-tungsten, and a wide range of "Endewrance" heat and wear resistant materials. Also shown will be castings in gunmetal, stainless steel and monel, and nickel copper, nickel-molybdenum and nickel-silicon-copper alloys.

Tin Council Statistics

Mine production of tin-in-concentrates in the Federation of Malaya amounted to 4,577 tons in August, compared with 5,170 tons in July, according to advance statistics published by the International Tin Council. Output in Thailand totalled 1,241 tons in August against 1,061 tons in July. Bolivian production in July was 1,800 tons against 1,224 in June. Output in Indonesia was 1,717 tons in August, 1,789 in July and 1,673 in June. Smelter production of tin metal in Malaya and Singapore during August amounted to 6,505 tons, compared with 7,211 tons in July and 6,877 tons in June. Output in the United Kingdom was 1,842 tons in August, against 2,062 tons in July.

Exports of tin-in-concentrates from Indonesia amounted to 1,564 tons in July, 1,498 tons in June and 638 tons in May. Exports from Bolivia totalled 945 tons in July, against 1,583 tons in June. Exports from Thailand in August were 1,483 tons, compared with 749 tons in July and 1,454 tons in June. Imports of tin-in-concentrates into Malaya and Singapore in August totalled 2,240 tons (provisional) against 1,420 tons in July. Imports into the U.K. were 2,220 tons in August, compared with 1,746 tons in July.

Exports of tin metal from Malaya and Singapore were 7,702 tons (provisional) in September, against 6,817 tons in August and 6,050 tons in July. U.K. August exports amounted to 456 tons against 1,661 tons in July. The Netherlands exported 347 tons in August, against 1,170 tons in July. Imports of tin metal into the U.S. totalled 4,904 tons in July against 3,020 tons in June. Imports into the U.K. amounted to 116 tons in August, compared with 255 tons in July. Provisional figures indicate that imports into Japan amounted to 5,981 tons during the first six months of 1961. No comparison was given by the Tin Council.

Stocks of tin-in-concentrates in Indonesia totalled 3,156 tons at the end of July, 3,095 tons at the end of June, and 1,966 tons at the end of May. Bolivian stocks at the end of July amounted to 1,743 tons, against 1,086 tons at the end of June.

Stocks at smelters in the U.K. totalled 1,505 tons at the end of August, against 1,162 tons at the end of July. Consumption of primary tin metal in the U.S.A. in July totalled 3,920 tons against 4,420 tons in June, while consumption in the United Kingdom was 1,440 tons in August, 1,725 tons in July and 1,807 tons in June.

Forthcoming Meetings

October 25 — Institution of Production Engineers. Manchester Branch. Reynolds Hall, College of Science and Technology, Manchester. "Explosive Forming." Dr. W. S. Hollis. 7.15 p.m.

October 25 — Manchester Metallurgical Society. Headquarters of the Manchester Literary and Philosophical Society, George Street, Manchester. "Education in the Metallurgical Field." Mr. L. W. Derry, Prof. H. O'Neill and Mr. D. R. O. Thomas. 6.30 p.m.

October 26 — Birmingham Metallurgical Society. College of Technology, Gosta Green, Birmingham, 4. Presidential Address. Mr. S. Heslop. 6.30 p.m.

October 26—Southampton Metallurgical Society. Southampton University. "Metallurgy of Uranium." Mr. J. J. Stobo. 7.15 p.m.

October 27—Institute of Metal Finishing. Sheffield and North-East Branch. Grand Hotel, Sheffield. "Recent Developments in Bright Silver Plating." 7 p.m.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week fell 252 tons to 4,757 tons, comprising London 1,796, Liverpool 1,517 and Hull 1,444 tons.

Copper stocks fell 2,325 tons to 18,185 tons, distributed as follows: London 450, Liverpool 15,035, Birmingham 50, Manchester 2,575, Hull 50 and Glasgow 25 tons.

Lead duty-free stocks fell 150 tons to 7,057 tons, comprising London 6,757, Glasgow 200 and Swansea 100 tons. In-bond stocks fell 75 tons to 3,527 tons, all in London.

Zinc duty-free stocks rose 1,395 tons to 6,669 tons, comprising London 2,558, Glasgow 31, Hull 450, Manchester 300, Liverpool 55 and Avonmouth 3,275 tons. In-bond stocks fell 150 tons to 2,953 tons, all in London.

Aluminium in Norway

Construction work has started on the expansion of capacity at the north Norwegian aluminium plant A/S Mosjoem Aluminium. Annual capacity is to be raised from the present level of 32,000 tons to 51,000 tons by mid-1963. Mosjoem Aluminium is jointly owned by Elektrokemisk A/S, of Oslo, and the Swiss undertaking, Aluminium Industrie A.G.

A Design Conference

In connection with their stand at the forthcoming Engineering Materials and Design Exhibition, to be held in London, at Earls Court, next month, the **Association of Bronze and Brass Founders** is holding a Design Conference at the Clarendon Restaurant, Hammersmith, London, W.6, on Tuesday, November 14, commencing at 10 a.m.

Subjects to be discussed during the meeting are as follows:—(a) The Design Engineer's Requirements from the Copper Alloy Foundry Industry; (b) Good Casting Design; and (c) Metallurgical Advances and Developments.

After a break for luncheon, the meeting will end with remarks from the chairman. This conference forms part of the Association's campaign for the promotion of the use of copper alloy castings. Full information may be obtained from the secretaries of the Association at 69 Harborne Road, Edgbaston, Birmingham, 15.

New Tirfor Model

A new model, the T.7, has been added to the Tirfor range of lifting and hauling devices by Tirfor Ltd., an associate company of **G. E. Simm (Engineering) Ltd.** It has been designed for the many applications which do not require the same capacity as the larger T.13 and T.35 models. The T.7 weighs only 13 lb., but has a lifting capacity of 15 cwt. Typical applications are in garages, factories, small

shipyards, flour mills, timber yards and on building and civil engineering sites.

The T.13, weighing 39 lb., has a lifting capacity of 30 cwt. The T.35, weighing 59 lb., has a lifting capacity of three tons. All three Tirfor models can raise, lower or haul, forwards or in reverse, with fine control, over any distance and with any length of rope or chain.

Curtain Walling

In the construction of the Granada T.V. Centre at Manchester, the front and rear walls of the 10-storey administration block are of curtain wall construction, and were supplied by **Norstel and Templewood Hawksley Ltd.**, a member of the Hawker Siddeley group.

The method of construction was as follows: anodized aluminium vertical hollow mullions span from floor to floor and carry transoms on spigot castings, thus providing a complete metal grid framework for the walls. The spaces within this grid are filled with horizontal lines of fixed and opening light windows with special spandrel panels beneath, which are made of vitreous enamelled steel backed by Asbestolux sheets.

The two curtain walls, which reduce the building time considerably, cost £45,000 and are self-decorative. The anodized aluminium framework has a natural silver colour and surrounds the semi-gloss grey enamel finish of the spandrel panels. No further decoration is necessary.

To comply with fire regulations, a concrete backing wall was constructed behind the curtain wall on each floor. The next stage of the development on this site is the construction of a further studio and dressing room block and this is now well advanced. Special curtain walling is again being supplied by Norstel and Templewood Hawksley Limited.

Associate Membership

It has been decided by the Council of the **Association of Bronze and Brass Founders** that, in order to widen the influence of the Association, associate membership should be available to suppliers in the foundry trade, and others whose membership would benefit the Association.

Applications from such firms who are interested are invited, and communications should be sent to the secretaries of the Association at their Birmingham headquarters.

Laboratory Equipment

An interesting eight-page brochure has been produced by the **Shandon Scientific Company Ltd.**, in which the company's range of equipment for the metallurgical laboratory is detailed. All procedures in specimen preparation have been covered, from the initial cutting off of a specimen, through the stages of mounting under controlled conditions of temperature and pressure, to the final grinding and polishing preparatory to microscopic examination. Statistics and photographs are also included in the brochure.

Opportunities in Engineering

A very sound policy of the **Brockhouse Organization** is the schemes of training within the group of companies in order to provide the wide variety of men necessary to such an undertaking. Apprenticeship can be obtained in practically all skilled engineering trades. In addition, facilities are provided for part-time day attendance at a local technical college, without loss of pay. The normal age of entry to an apprenticeship is from 16 to 17 years, but boys can be accepted before this, as probationers.

A description of these apprenticeship schemes is given in a 16-page illustrated brochure issued by the Organization. The training schemes cater for craft apprentices (16 to 21 years) and student apprentices (17 to 21 years). Applicants for this latter group will normally have reached the School Certificate or National Certificate standard. Members of this group are eligible for advanced practical and theoretical training, leading to Higher National Certificates, membership of professional institutions, and university degrees, etc. The object of the training in this group is to produce executives for all branches — managers, engineers, chemists, accountants, etc.

Craft apprentices are given a progressive course through selected works departments, combined with theoretical instruction at technical college part-time day classes or evening classes. The object of this training is to produce skilled craftsmen for the particular requirements of each factory.

New Primary Mill

It is reported that **Davy and United Engineering Company Limited** has secured a contract from The Park Gate Iron and Steel Company Limited to build a 42 in. by 104 in. reversing blooming mill, complete with a full range of auxiliary equipment, for the new integrated steelworks which Park Gate are now establishing on a new site on the outskirts of Rotherham. The value of the contract is approximately £1,000,000.

Upgrading of Minerals

Recent news from New Jersey reports that the Minerals and Chemicals Philipp Corporation has announced it expects to open a new 2,000,000 dollar plant in McIntyre, Georgia, early in 1962. The plant is being built to put into use an ultra-flotation process the company has developed for upgrading minerals and ores and securing greater yields per ton. It will be a multi-ton per hour plant and the method will be open to licensing.

The process was originally developed to improve kaolin clays by floating out discolouring minerals. The process, it is believed, can be adapted to recovering commercial quantities of various metallic and non-metallic substances from waste tailings now dumped at mine sites. The process can be applied to phosphate, low-grade bauxite, low grade mesabi iron ores, Utah beryllium ores, fluorspar, Bolivian tin ores, and uranium.

U.S. Lead Production

U.S. production of recoverable lead in August 1961 totalled 21,500 tons, according to the Bureau of Mines, United States Department of the Interior. This compares with the July output of 20,800 tons.

The January-August 1961 production of 177,100 tons was four per cent above that in the same period of 1960. The price of common grade lead remained unchanged at 11 cents a lb. on the New York market throughout August. The price was established on December 13, 1960.

A.S.T.M. Changes Name

Reports from the U.S.A. state that the name of the American Society for Testing Materials was officially changed to the **American Society for Testing and Materials** with the signing of a court decree on September 18, 1961, amending the Society's Charter originally granted in 1902 by the Commonwealth of Pennsylvania.

In announcing this change, A.S.T.M. President Miles N. Clair said: "The inclusion of the word 'and' in the Society's name places added emphasis on the Society's research work in seeking knowledge of the nature of materials".

Wall Thickness Gauge

An addition to the standard range of "Teddington" air gauges is an adjustable wall thickness gauge introduced by **Teddington Industrial Equipment Ltd.** This is designed to measure the wall thickness of plain bearings, cylindrical bushings and similar parts. It is stated that this gauge will measure components from $1\frac{1}{2}$ in. to $7\frac{1}{2}$ in. i.d. and with up to $\frac{5}{8}$ in. wall thickness. In addition to thickness, the gauge will measure i.d/o.d. concentricity by variation in wall thickness as the part is rotated in the gauge.

Open gauging nozzles are used, thus there are no contacts to mark the workpiece. In addition, the tungsten carbide wear surfaces are superfinished to a surface finish of approximately 1 micro-in. Adjustable support arms are fitted, but these play no part in measurement, and merely serve to support the workpiece in the gauging position.

A particular feature of the gauge is the ease of setting up. A pneumatic span-setting master is built into the gauge and the pneumatic calibration can be readily checked by turning a knob. All that is then required is a nominal size master to enable the adjustable upper nozzle to be positioned correctly for the particular size of workpiece. The nominal master may be either a flat slip gauge or a workpiece of accurately known size.

To give fast, easy measurement, the gauge is designed with the maximum clearance, and this is 0·002 in. to 0·003 in. beyond the thickest part that can be measured at any particular setting. The indicator gauge is liquid filled and sealed, giving a fast positive pointer movement.

The gauge may have one of two measuring ranges—$\pm$0·001 in. reading to 0·0001 in. (magnification 1,800) or $\pm$0·002 in. reading to 0·0002 in. (magnification 900).

An air supply at any pressure between 60 and 150 lb/in^2 is required, and the gauge is supplied complete with air filter, with supply pressure gauge and 4 ft. of connecting hose.

Project Engineering Services

The Power-Gas Corporation Limited designs, supplies and erects plant and equipment for the chemical, petrochemical, petroleum, gas, iron and steel, and nuclear energy industries, and in a new brochure of some 32 pages details of these services are described and illustrated. A complete construction service to the process industries from flow sheet or from technical design to completion of erection is provided. All aspects of constructional engineering, including civil, mechanical and structural, are available, depending on a client's requirements.

New Insulating Product

Details of a completely new process for the manufacture of refractory insulating bricks and special shapes—known as the

"23" range—have now been released by **Thos. Marshall and Co. (Loxley) Ltd.**, parent company of Kingscliffe Insulating Products Ltd. and head of the Marshalls Refractories group of companies. Both standard rectangular shapes (density 48 lb/ft³) and specials (60 lb/ft³) have a service temperature of 2,300° F.

The Kingscliffe method (patents pending) makes a complete break with the traditional process in which a mixture of clay and combustible is kilned in order to produce an oversize, often heat-distorted, block, from which the finished brick has to be machined. By using the Kingscliffe method, it is said, the need for a combustible constituent is entirely eliminated, and the as-kilned product is true to shape and ready for despatch. Production rate is stated to be twice that of the traditional system.

Typical applications for the "23" series of insulating products are in metallurgical heat-treatment furnaces, oil refinery furnaces, ceramic kilns and steam generators. They are particularly suitable where a high load-bearing strength is required.

A Birmingham Event

Held at the Grand Hotel, Birmingham, on Thursday last, the twenty-fourth annual ball of the Royal Metal Trades Pension and Benevolent Society again proved successful, both as a social occasion and a charitable effort. Some 450 people attended, including the chairman of the board of management of the society, thus linking the Midland area with the executive in London. The ball was held under the patronage of the Lord Mayor of Birmingham, who was unfortunately unable to be present. He was, however, represented by Alderman John Lewis.

Distributors' Conference

A very successful three-day conference took place early this month in Weybridge, Surrey. It was organized by **Electro-Chemical Engineering Co. Ltd.**, a subsidiary of Efco Ltd., and was attended by 28 representatives of the Efco-Udylite organization in Europe. Also present were Mr. L. K. Lindahl, chairman of the board of The Udylite Corporation, Detroit; Dr. Henry Brown, director of research of The Udylite Research Corporation; and Mr. J. Barton, chief engineer of Frederic B. Stevens Inc., U.S.A.

Important developments in new processes and equipment were discussed, including the new Satylite process which will shortly be launched throughout Europe. This plating process produces an attractive satin finish direct from a nickel bath. Mr. Lindahl took the opportunity of announcing that a merger had been agreed between the boards of Metal and Thermit Corporation and The Udylite Corporation, Detroit. It is understood that the merger is subject to the approval of the stockholders of each corporation.

Social events during the conference included a cocktail party given by Mr. A. Smart, managing director of Electro-Chemical Engineering Co. Ltd., and Mrs. Smart, and a dinner at the House of Commons sponsored by Mr. J. Page, M.P. for Harrow West.

Spray Pistol Demonstration

A party of engineers, seventy strong, from the North-West, North Midlands and Lancashire recently visited the Trafford Park Works of the Coating Division of **F. W. Berk and Co. Ltd.** They were shown the full range of the Division's products and services, with special emphasis on the new Berk 61 metal spray pistol, on Berk spray booths, and on grit-blasting equipment. In the field of plastics coatings, Berk can offer spray application and fluidization in the new Berk Powdaerator.

The Berk 61 is for large metal spraying operations. It provides a throughput of 110 lb. of zinc powder per hr., with a deposition efficiency, it is said, hitherto only achievable with low throughput guns. It weighs only 3 lb., is carefully balanced, and the only parts subject to wear are the nozzles and the hoses feeding the powder.

The new Berk Powdaerator consists of a fluidizing tank operated by a detachable fan and agitator. This arrangement permits several tanks to be serviced by one powered unit, thereby reducing the capital cost of equipment required to produce, concurrently, coatings in more than one colour.

For grit-blasting, the heavy duty Model 4522 machine will operate for up to 80 min. per loading, and the Model 4523 for up to 15 min. A new model, the Berk "Slim Jim", is similar in capacity to the 4523 but has been specially engineered for use in confined spaces — it can be passed through a manhole 15 in. by 23 in. All three models have a blasting rate of 90 ft²/hr. The range of shotblast machines is supplemented by blasting rooms, in standard or special sizes, protective clothing, dust extraction equipment, and remote control devices.

News from Birmingham

Rolling mills and foundries in the non-ferrous metal industries in the Birmingham area are supplying fair quantities of metal for early consumption in the light engineering industries. The motor trade is still operating below capacity and there seems little hope of any upward move this year, particularly as the strikes in different sections of the trade have held up work not only in the assembly shops, but have had repercussions on stampers, platers and makers of components generally. There is a good demand for pressings and castings used in the building trade.

Output of iron and steel is running on a basis of 77 per cent of capacity, and as many firms are still using up stocks there is little change expected in the near future. Replacement of out-of-date plant, however, is proceeding, and suppliers of this class of product continue busy. Rolling stock builders face a difficult period. One Midland firm has announced its intention to cease production altogether and seek manufacture of other products rather than close down the factory. There is still a brisk market for constructional steel of all descriptions. Iron foundries are operating below capacity, and supplies of pig iron are more than adequate for requirements.

Company Reports

Fescol Ltd.

Interim dividend 5 per cent on capital increased by one-for-two scrip issue, for 1961 (single payment equal to 11¼ per cent included bonus equivalent to 1¼ per cent).

Metal Industries Ltd.

A new M.I. company is being set up in Canada. It will be known as Dominion M.I. Limited, and it will have its head office and works in Montreal, with a branch office and repair department in Toronto. The new company is to commence operations on November 1 next, will be concerned with the promotion of the M.I. group's products in the Canadian market and with the manufacture of specialized electrical control systems and equipment. The President and general manager of the new company will be Mr. E. A. Chandler, and the general sales manager will be Mr. D. J. Tamblyn.

E. Chalmers and Company

Group net profit, year to August 31, 1961, £20,330 (£31,514) and dividend 15 per cent (17½). Current assets £558,178 (£534,881), liabilities £222,068 (£180,452).

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Lakedale Plating Company Limited (702240), Old Tramyard, Lakedale Road, Plumstead. Registered September 1, 1961. To carry on the business of electro, chromium and general platers, etc. Nominal capital, £1,800 in £1 shares Directors to be appointed by subscribers.

Leonard P. Rock Limited (702242), Corngreaves Sidings, Cradley Heath, Staffs. Registered September 1, 1961. To carry on the business of importers, exporters and dealers in scrap metal, Government surplus materials, etc. Nominal capital, £6,000 in £1 shares. Director: Leonard P. Rock, Geoffrey Rock and Mrs. Beatrice E. Rock.

Steel Alloys Limited (702214), 24-28 Cheapside, E.C.2. Registered September 1, 1961. To carry on the business of merchants, dealers, importers, exporters, refiners and brokers of and in all chemicals and minerals and all metals, etc. Nominal capital, £1,000 in £1 shares. Directors: Ernst Herman and John G. Lowenstein.

Dex Corrosion Control Limited (702294), 25 Victoria Street, S.W.1. Registered September 4, 1961. To apply anti-corrosion treatments to metals and other materials, etc. Nominal capital, £1,000 in 980 "A" shares of £1 and 400 "B" shares of 1s. Directors: Ernest C. Mark and Donald C. C. Mark.

Bedford Plating Limited (702366), Boxworth End, Swavesey, Cambs. Registered September 5, 1961. To carry on the business of electroplaters, etc. Nominal capital, £1,000 in £1 shares. Directors: Keith L. Jones and Alan P. Jones.

Metal Market News

THOSE who were hoping for something definite following the second meeting of the Tin Council last week were disappointed with the statement issued at the conclusion of the talks. The tin market is still in doubt about the "floor" and the "ceiling" prices. The communique said that the upper and lower limits had been considered and it had been agreed that these were not appropriate for attaining the Tin Agreement's objectives. It would appear that a proposal to raise the "floor" price to £800 and the "ceiling" to £1,000 was not carried. The next meeting of the Tin Council is not scheduled to take place until February 14, when, it was stated, the price question would receive further consideration. By that time, the U.S. Congress should be back in session and more will be known about the prospects of a release from the American stockpile. In the meanwhile, the market looks like exhibiting a nervous and changeable tendency, but it is not easy to foresee much in the way of a higher price. True, demand is reasonably good but, not surprisingly, buyers are acting with a good deal of caution and are not disposed to enter into anything of a long-term nature. Last week opened on a firm note following the President's reassuring statement about the American Government's intention to protect producers' interests in the matter of any tin releases from the stockpile. There was a turnover of about 2,000 tons and, on balance, cash gained £5 at £944, while three months also closed £5 higher at £953. Stocks at the beginning of the week were reported 229 tons lower at 5,009 tons.

The week opened in copper with something of a shock, for without warning there was a drop of more than 2,000 tons in L.M.E. warehouse stocks. To be precise, the reduction amounted to 2,084 tons, and the revised total was 20,510 tons. Detailed examination of the distribution of the stocks shows the withdrawals to have been made from the port of Liverpool, and this suggests that the copper has been shipped away from the country. In spite of this fall in the reserves there was a reduction in the standard copper quotation on the first day of the week, three months declining by £2 5s. 0d. However, on the following day there was news of an advance in the U.S. scrap price and this served to encourage buyers on the London market. Moreover, consumer interest quickened appreciably, and a certain amount of influential buying was reported. An unsatisfactory development last week was the elimination of the contango, for on Thursday afternoon both cash and three months were quoted at £230.

Although trading in copper futures was quite active, the turnover did not reach the exceptionally large figure of the previous week. In all, some 18,775 tons changed hands, price alterations on balance amounting to a gain of £3 in cash at £232, and a gain of £2 in three months at £232 5s. 0d. At the close of business on Friday, there was a fairly strong conviction that further inroads would be made in L.M.E. stocks and it was, moreover, suggested that the copper was being shipped to China in fulfilment of purchases made by that country. Trading in both lead and zinc was not very brisk, but about up to average, and no special feature emerged in either of these metals. In lead, the turnover was reported to be about 7,125 tons, cash closing 5s. down at £63 5s. 0d., and three months lower by a similar amount at £64 15s. 0d. In zinc, some 6,850 tons changed hands, cash being quoted at £72 15s. 0d. and three months at £73 15s. 0d. on Friday afternoon. These prices showed gains of 15s. and 20s. for the respective positions.

New York

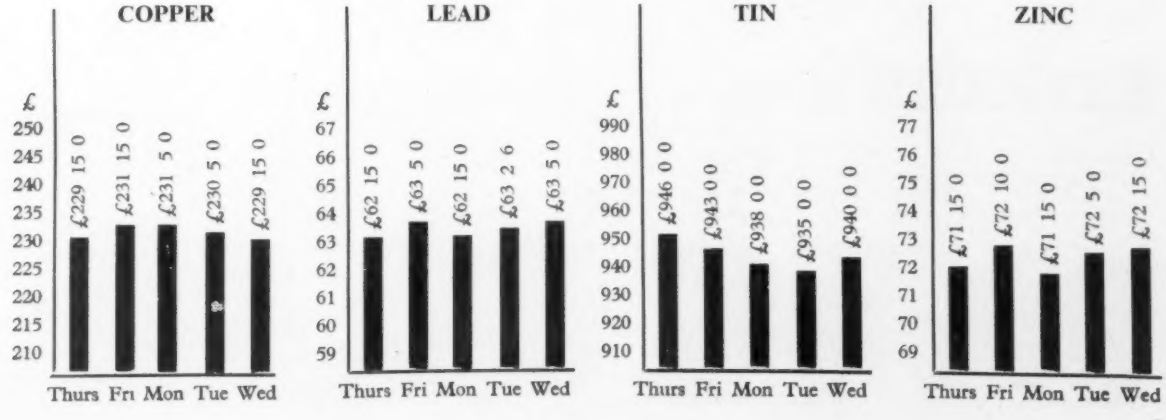
Copper futures were moderately higher on covering and new buying, aided by the advance in London and the higher scrap copper price. In physical copper, dealers noted quiet, steady conditions, while custom smelters reported that November inquiry was developing satisfactorily. Producers indicated fair November demand. Leading custom smelters raised their buying price for scrap by $\frac{1}{2}$ cent to 25$\frac{1}{2}$ cents/lb. to encourage offerings.

Tin was steady and quiet. Spot was offered at 121$\frac{1}{4}$ cents/lb., November at 120$\frac{7}{8}$ and December/January at 120$\frac{5}{8}$ cents/lb. Lead was quite active in some directions, while prime western zinc was fair. Special high grade moved in modest quantities. In late dealings, tin was steady in the nearby positions but showed a softer trend in forwards. Trading was quiet. Spot was offered at 121$\frac{1}{4}$ cents, November at 120$\frac{1}{4}$, December at 120$\frac{1}{2}$, and January at 120$\frac{3}{8}$ cents/lb.

A forthcoming Congressional investigation of U.S. stockpile policies, particularly those applying to sales of natural rubber, has stirred little reaction among Government officials. A spokesman for the Office of Emergency Planning, successor agency to the Office of Civil Defense Mobilization, which directs U.S. stockpile policy, said he understood such an inquiry had been started.

London Metal Exchange

Thursday 12 October to Wednesday 18 October 1961



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NON-FERROUS

PRIMARY METALS

All prices quoted are those available at 2 p.m. 18/10/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	237	10	0
Antimony Metal 99%	„	230	0	0
Antimony Oxide Commercial	„	194	10	0
Antimony White Oxide	„	212	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		11	0
Calcium	„	2	0	0
Cerium 99%	„	15	0	0
Chromium	„		6	11
Cobalt	„		12	0
Columbite per unit			8	10
Copper H.C. Electro	ton	229	15	0
Fire Refined 99·70%	„	228	0	0
Fire Refined 99·50%	„	227	0	0

		£	s.	d.
Copper Sulphate	ton	77	0	0
Germanium	grm.		—	
Gold	oz.	12	10	0¼
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	63	5	0
Magnesium Ingots	lb.			
99·8%	„		2	2½
99·9+%	„		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		5	6
Alloy Ingot, AZ91X		1	11¾-2	1¼
Manganese Metal	ton	280	0	0
Mercury	flask	62	0	0
Molybdenum	lb.	1	15	0
Nickel	ton	660	0	0
F. Shot	lb.		5	11
F. Ingot	„		5	11
Osmium	oz.	20	0	0
Osmiridium	„		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	„	30	5	0
Rhodium	„	46	0	0
Ruthenium	„	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	123	0	0
Silver Spot Bars	oz.		6	7¾
Tellurium Sticks	lb.	2	0	0
Tin	ton	940	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	73	3	9
Dust 95/97%	„	118	10	0
Dust 98/99%	„	124	10	0
Granulated 99+%	„	98	3	9
Granulated 99·99+%	„	110	13	9

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

All prices quoted are those available at 2 p.m. 18/10/61

Aluminium Alloy (Virgin)	£	s.	d.
B.S. 1490 L.M.5 ton	nom.		
B.S. 1490 L.M.6 „	„		
B.S. 1490 L.M.7 „	„		
B.S. 1490 L.M.8 „	„		
B.S. 1490 L.M.9 „	„		
B.S. 1490 L.M.10 „	„		
B.S. 1490 L.M.11 „	„		
B.S. 1490 L.M.12 „	„		
B.S. 1490 L.M.13 „	„		
B.S. 1490 L.M.14 „	„		
B.S. 1490 L.M.15 „	„		
B.S. 1490 L.M.16 „	„		
B.S. 1490 L.M.18 „	„		
B.S. 1490 L.M.22 „	„		
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 ton	150	0	0
B.S. 1490 L.M.2 „	150	0	0
B.S. 1490 L.M.4 „	159	0	0
B.S. 1490 L.M.6 „	176	0	0
***Aluminium Bronze**			
BSS 1400 AB.1 ton	240	0	0
BSS 1400 AB.2 „	247	0	0

		£	s.	d.
***Brass**				
BSS 1400-B3 SCB2 ton	177	0	0	
BSS 249 „	173	0	0	
***Gunmetal**				
B.S. 1400: LG2 d/d „	213	0	0	
B.S. 1400: LG3 d/d „	224	0	0	
B.S. 1400: GI 1½ Pb d/d „	284	0	0	
B.S. 1400: GI ½ Pb d/d „	298	0	0	
***Manganese Bronze**				
BSS 1400 HTB1 „	195	0	0	
BSS 1400 HTB2 „	214	0	0	
BSS 1400 HTB3 „	230	0	0	
Nickel Silver				
Casting Quality 12% „	255	0	0	
„ „ 16% „	265	0	0	
„ „ 18% „	310	0	0	
***Phosphor Bronze**				
B.S.1400P.B.1.(A.I.D. released) „	315	0	0	
B.S. 1400 L.P.B.1 „	238	0	0	

**Average prices for the last week-end.*

Phosphor Copper	£	s.	d.
10% ton	252	0	0
15% „	255	0	0
Phosphor Tin			
5% „	1022	0	0
Silicon Bronze			
BSS 1400-SB1 „	280	0	0
Solder, soft, BSS 219			
Grade C Tinmans „	420	0	0
Grade D Plumbers „	332	15	0
Grade M „	463	15	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 „		—	
Zinc Alloys			
BSS 1004 Alloy A ton	104	3	9
BSS 1004 Alloy B „	108	3	9
Sodium-Zinc lb.		2	6

SCRAP METALS

Merchants' average buying prices delivered, per ton, 17/10/61

Aluminium	£
New Cuttings	134
Old Rolled	100
Segregated Turnings	72
Brass	
Cuttings	160
Rod Ends	144
Heavy Yellow	135
Light	130
Rolled	147
Collected Scrap	131
Turnings	137

Copper	£
Wire	203
Firebox, cut up	201
Heavy	200
Light	197
Cuttings	208
Turnings	194
Braziery	165
Gunmetal	£
Gear Wheels	199
Admiralty	199
Commercial	180
Turnings	178

Lead	£
Scrap	53
Nickel	
Cuttings	—
Anodes	590
Phosphor Bronze	
Scrap	180
Turnings	178
Zinc	
Remelted	64
Cuttings	54
Old Zinc	35

METAL PRICES

SEMI-FABRICATED PRODUCTS

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products

Aluminium				£	s.	d.
Sheet	10	S.W.G.	lb.		2	10½
Sheet	18	S.W.G.	,,		3	0½
Sheet	24	S.W.G.	,,		3	3½
Strip	10	S.W.G.	,,		2	10½
Strip	18	S.W.G.	,,		2	11½
Strip	24	S.W.G.	,,		3	1
Circles	22	S.W.G.	,,		3	4½
Circles	18	S.W.G.	,,		3	3½
Circles	12	S.W.G.	,,		3	2½
Plate as rolled			,,		2	10
Sections			,,		3	4
Wire 10 S.W.G.			,,		3	1½
Tubes 1 in. o.d. 16 S.W.G.			,,		4	4
Aluminium Alloys						
BS 1470. HS19W.						
Sheet	10	S.W.G.	,,		3	3
Sheet	18	S.W.G.	,,		3	5½
Sheet	24	S.W.G.	,,		4	1
Strip	10	S.W.G.	,,		3	3
Strip	18	S.W.G.	,,		3	4½
Strip	24	S.W.G.	,,		4	0½
BS1477. HP30M.						
Plate as rolled			,,		3	1
BS1470. HC15WP.						
Sheet	10	S.W.G.	,,		4	3
Sheet	18	S.W.G.	,,		4	8½
Sheet	24	S.W.G.	,,		5	8½
Strip	10	S.W.G.	,,		4	4
Strip	18	S.W.G.	,,		4	8½
Strip	24	S.W.G.	,,		5	4½

Aluminium Alloys—cont.		£	s.	d.
BS1477. HPC15WP. Plate heat treated	lb.		3	10½
BS1475. HG19W. Wire 10 S.W.G.	,,		4	2
BS1471. HT19WP. Tubes 1 in. o.d. 16 S.W.G.	,,		5	5
BS1476. HE19WP. Sections	,,		3	4
Split tube 19 S.W.G. (½″)	,,		4	2
20 S.W.G. (⅜″)	,,		3	11
21 S.W.G. (⅜″)	,,		4	1
22 S.W.G. (¼″)	,,		4	11
Welded tube 14 to 20 S.W.G. (sizes ½″ to 1½″)	,,	3	10½	to 5 8½
Brass				
Tubes	lb.		1	9¾
Brazed Tubes	,,		3	1¾
Drawn Strip Sections	,,		3	1¾
Sheet	ton	198	10	0
Strip	,,	198	10	0
Extruded Bar	lb.		2	0½
Condenser Plate (Yellow Metal)	ton	184	0	0
Condenser Plate (Naval Brass)	,,	198	10	0
Wire	lb.		2	8¾

Beryllium Copper		£	s.	d.
Strip	lb.	1	4	11
Rod	,,	1	1	6
Wire	,,	1	4	9
Copper				
Tubes	lb.		2	3⅜
Sheet	ton	266	0	0
Strip	,,	266	0	0
H.C. Wire	,,	285	5	0
Cupro Nickel				
Tubes 70/30	lb.		3	8¾
Lead				
Pipes (London)	ton	103	5	0
Sheet (London)	,,	101	0	0
Tellurium Lead	,,	£6 extra		
Nickel Silver				
Sheet and Strip 10%	lb.		3	11½
Wire 10%	,,		4	4½
Phosphor Bronze				
Wire	,,		4	2⅛
Titanium (1,000 lb. lots)				
Billet 4½″ to 18″ dia.	lb.	47/-		48/-
Rod ¼″ to 4″ dia.	,,	85/-		53/-
Wire ·036″·232″ dia.	,,	159/-		99/-
Strip ·001″ to ·048″	,,	350/-		68/-
Sheet 8′×2′. 20 gauge	,,	73/-		
Tube, representative average gauge	,,	198/-		
Extrusions	,,	90/-		
Zinc				
Sheet	ton	110	5	0
Strip	,,	nom.		

FOREIGN QUOTATIONS

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

Belgium	fr/kg	£/ton
Copper: electrolytic	31.75	232 1
Tin	131.85	963 13

Canada	c/lb	£/ton
Aluminium	24.00	194 8
Copper: electrolytic	30.00	243 0
Lead	10.50	81 0
Nickel	70.00	567 0
Zinc: Prime western	12.00	97 4
High grade 99.95	12.60	102 1
High grade 99.99	13.00	105 6

France	fr/kg	£/ton
Aluminium	2.43	179 11
Antimony 99·0	2.80	206 18
Cadmium	16.25	1,200 17
Copper: electrolytic	3.21	237 4
Lead	.93	68 14
Nickel	9.00	665 2
Tin	13.51	999 17
Zinc: Thermic	1.07	79 1
Zinc: electrolytic	1.15	85 0
Scrap		
Copper: electrolytic	2.85	210 12
Heavy copper	2.85	210 12
No. 1 copper wire	2.70	199 10
Brass rod ends	2.12	156 13
Zinc castings	.87	64 5
Lead	.87	64 5
Aluminium	1.80	133 0

Italy	lire/kg	£/ton
Aluminium	370	216 1
Antimony 99·0	485	283 4
Copper: wire bars 99·9	450	262 16
Lead	165	96 8
Nickel	1,300	805 14
Tin	1,840	1,074 11
Zinc: electrolytic	181	105 15
Scrap		
Aluminium soft sheet clippings (new)	305	178 2
Lead, soft, first quality	137	80 0
Lead, battery plates	77	45 19
Copper, first grade	370	216 0
Bronze, commercial gunmetal	420	245 7
Brass: heavy	275	160 12
Brass: light	260	152 16
Brass, bar turnings	275	160 12
Old zinc	107	62 10

Switzerland	fr/kg	£/ton
Aluminium	2.50	210 5
Copper: electrolytic	2.82	237 3
Lead	.80	67 5
Nickel	7.70	647 11
Tin	11.65	979 15
Zinc: High grade 99.99	.99	83 5

Japan	Yen per metric ton
Scrap	
Copper: electrolytic	288,000
Copper wire No. 1	262,000
Copper wire No. 2	255,000
Heavy copper	252,000
Light copper	237,000
Brass, new cuttings	197,000
Red brass scrap	218,000

West Germany *Scrap*	D-marks per 100 kilos	£/ton
Used copper wire	220	200 8
Heavy copper	216	196 15
Light copper	190	173 1
Heavy brass	145	132 1
Light brass	110	100 5
Soft lead	50	45 11
Zinc	50	45 11
Used aluminium unsorted	90	82 0

United States	c/lb	£/ton
Aluminium	24.00	191 5
Antimony 99·0	32.50	259 0
Cadmium	160.00	1,275 4
Copper: electrolytic	31.00	247 10
Lead	11.00	87 13
Nickel	81.35	648 7
Tin	121.00	964 7
Zinc: electrolytic	12.50	99 12

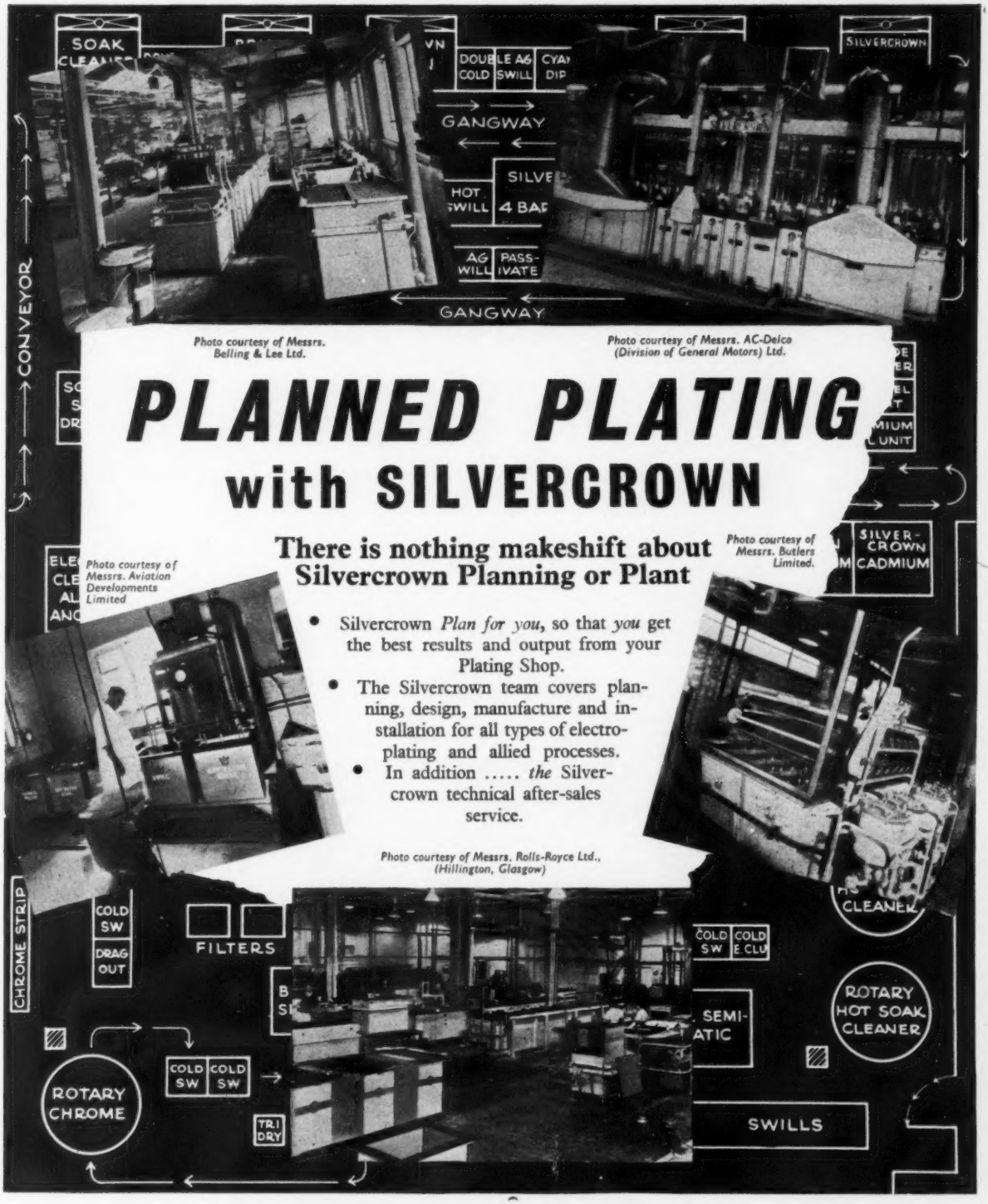
THE STOCK EXCHANGE

Bank-Rate Change Failed To Restore Confidence

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 17 OCTOBER	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	28/9	—9d.	11	9	7 13 0	33/9	26/3	35/–	26/6
400,000	2/–	Anti-Attrition Metal	1/3		NIL	4	NIL	1/3¾	0/9	1/6	0/9
43,133,593	Stk. (£1)	Associated Electrical Industries ...	28/9	—1/4½	15	15	10 8 9	54/10½	28/9	67/3	38/3
3,895,963	1	Birfield	62/–		10	15‡	3 4 6	78/9	45/–	51/3	29/–
4,795,000	1	Birmid Industries	69/–	—6/6	20	20D	5 16 0	103/–	68/3	74/9	56/–
8,445,516	Stk. (10/–)	Birmingham Small Arms	19/3	—1/3	17½QT	12½	6 2 3	36/10½	19/3	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	12/6		5	5	8 0 0	14/6	12/3	17/4½	14/9
476,420	Stk. (£1)	Ditto Cum. B. Pref. 6%	15/6		6	6	7 14 9	17/6	15/6	20/–	17/1½
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	16/3	+3d.	6	6	7 7 9	18/–	15/3	21/1½	17/7½
18,846,647	Stk. (£1)	British Insulated Callender's Cables	54/6	—2/–	13½	13½	4 19 0	62/3	49/–	61/4½	47/–
7,670,837	5/–	British Oxygen Co. Ltd., Ord. ...	15/–	—1/9	16D	16	3 11 0	28/4½	15/–	35/–	19/10½
1,200,000	Stk. (5/–)	Canning (W.) & Co.	14/3		15⅝	25+*2½C‡	5 1 6	20/9	13/7½	19/9	13/7½
60,484	1/–	Carr (Chas.)	1/–	—1½d.	NIL	12½	—	1/7½	10½d.	2/3	1/–
555,000	1	Clifford (Chas.) Ltd.	29/–		12	10	8 5 6	31/–	26/–	35/–	28/9
45,000	1	Ditto Cum. Pref. 6%	15/–		6	6	8 0 0	15/3	15/–	16/–	15/10½
1,166,000	Stk. (2/–)	Clifford Components V	8/–		25*2½C	25*2½C	6 5 0	10/1½	7/3	11/9	6/10½
300,000	2/–	Coley Metals	3/–	—1½d.	15	15	10 0 0	4/5½	3/–	5/–	3/4½
10,185,696	1	Cons. Zinc Corp.†	61/6	—1/–	20	15	6 10 0	81/6	61/3	80/9	59/6
5,399,056	5/–	Davy-Ashmore	34/3	—5/9	27½	22½	4 0 3	44/6	32/6	147/3	99/6
8,000,000	5/–	Delta Metal	20/–xd	—1/1½	20	17½	5 0 0	27/7½	19/9	28/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	37/3		15	15	8 1 0	52/3	36/6	56/9	45/–
1,155,000	1	Evered & Co.	43/6		10	10φB	4 12 0	45/9	42/6	42/9	29/3
18,000,000	Stk. (£1)	General Electric Co.	24/3	—1/6	10	10	8 5 0	39/6	24/3	47/9	29/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	50/9	—2/–	25	20	4 18 6	65/–	42/9	52/6	40/–
937,500	5/–	Glacier Metal Co. Ltd.	16/3	—9d.	15	13	4 12 3	21/1½	13/9	16/1½	11/1½
2,750,000	5/–	Glynwed Tubes	23/6	—1/–	22½	25¶	4 15 9	30/3	23/–	27/6	17/–
7,228,065	10/–	Goodlass Wall & Lead Industries ...	28/–	—2/–	15	19L	5 7 3	44/9	28/–	41/9	33/–
696,780	10/–	Greenwood & Batley	16/3		15	30‡	9 4 6	29/6	16/3	33/6	29/1½
792,000	5/–	Harrison (B'ham) Ord.	9/–		*10	*20‡	5 11 0	14/6	8/9	15/10½	11/9
150,000	1	Ditto Cum. Pref. 7%	18/–		7	7	7 15 6	20/4½	18/–	23/6	22/–
1,612,750	5/–	Heenan Group	13/6		13	15	4 16 3	17/1½	10/6	13/–	9/10½
251,689,407	Stk. (£1)	Imperial Chemical Industries ...	57/–	—3/–	13½	11½	4 14 9	81/6	57/–	76/6	54/–
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	14/9		5	5	6 15 6	16/–	13/10½	18/–	15/4½
29,196,118	**	International Nickel	145		$1.60	$1.50	1 17 6	160	104	105	84½
6,000,000	1	Johnson, Matthey & Co.	69/3	+1/6	15	12	4 6 9	75/–	57/6	67/6	44/9
600,000	10/–	Keith, Blackman	17/6		17½	17½E	10 0 0	21/6	16/6	32/6	17/6
320,000	4/–	London Aluminium	11/6		13	12	4 10 6	15/–	8/6	12/6	7/10½
1,530,024	1	McKechnie Bros. A Ord.	32/6		12½K	17½F	7 13 9	53/3	32/6	69/3	55/–
1,108,268	5/–	Manganese Bronze & Brass	11/–	—6d.	20⅝	20⅝	9 9 3	18/6	10/9	18/6	13/4½
50,628	6/–	Ditto (7½% N.C. Pref.)	5/3		7½	7½	8 10 6	6/–	5/–	6/6	5/9
26,361,444	Stk. (£1)	Metal Box	79/–	—3/6	12	12M	3 0 9	100/9	68/3	84/3	61/–
415,760	Stk. (2/–)	Metal Traders	7/6		50	50	13 6 9	8/9	6/9	10/9	7/1½
240,000	1	Mint (The) Birmingham	33/9		15G	12½	5 18 3	35/9	24/–	39/–	33/6
80,000	5	Ditto Pref. 6%	71/6		6	6	8 7 9	77/6	71/6	80/–	75/–
274,152	1/–	Minworth Metals	5/6		30	30S	5 9 0	6/3	4/6¾	5/2½	3/10½
5,187,938	Stk. (£1)	Morgan Crucible A	59/9	—6d.	14	13	4 13 9	71/3	53/4½	63/–	47/6
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	14/6		5½	5½	7 11 9	17/–	13/10½	18/9	15/9
3,850,000	Stk. (£1)	Murex	37/6	—2/6	13	22½J	6 18 9	52/–	37/6	45/–	35/3
585,000	5/–	Ratcliffs (Great Bridge) Ord. ...	15/10½xd		10	10R	3 3 0	16/6	15/9	17/–	14/9
1,064,880	10/–	Sanderson Kayser	35/–		17½	35‡	5 0 0	41/3	29/–	40/3	27/7½
3,400,500	Stk. (5/–)	Serck	14/–	—6d.	12½	12½	4 9 3	19/3	13/9	25/6	15/3
212,384	5/–	Stadall & Co.	7/9		15	15	9 13 6	10/3	7/6	10/3	6/3
8,035,372	Stk. (£1)	Stone-Platt Industries	48/9	—1/6	16	15	6 11 3	67/–	48/9	64/4½	52/3
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	14/6		5½	5½	7 11 9	18/–	13/6	18/7½	15/3
35,344,881	Stk. (£1)	Tube Investments Ord.	55/6	—1/6	14	20	5 1 0	85/6	54/–	140/3	63/10½
41,000,000	Stk. (£1)	Vickers	26/6	—9d.	10	10	7 11 0	38/3	26/6	39/7½	27/1½
750,000	Stk. (£1)	Ditto Pref. 5%	13/–		5	5	7 13 9	15/–	12/4½	17/6	13/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	18/6	+3d.	*5	*5	8 3 6A	21/1½	18/–	24/6	20/1½
4,594,418	1	Ward (Thos. W.) Ord.	68/9	+6d.	13⅔	13⅔	4 0 0	84/6	64/6	94/–	63/–
7,109,424	Stk. (£1)	Westinghouse Brake	25/6	—3/9	11	10	8 12 6	46/3	25/–	60/6	37/6
323,773	2/–	Wolverhampton Die-Casting ...	8/–	—3d.	35	30	8 15 0	13/4½	7/10½	13/10½	8/1½
591,000	5/–	Wolverhampton Metal	21/6	—6d.	32½	32½	7 11 3	30/–	21/3	39/9	23/9
156,930	2/6	Wright, Bindley & Gall	4/3		15	20‡	8 16 6	4/9	3/7½	4/6	2/10½
124,140	1	Ditto Cum. Pref. 6%	12/9		6	6	9 8 3	13/7½	12/9	15/–	13/6
150,000	1/–	Zinc Alloy Rust Proof	4/3		40	30	9 8 3	5/6	4/3	5/4½	4/–

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡and 100% capitalized issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. φ and 6¼% from Capital Profits. B and 50% capitalized issue. G and 50% capitalized issue. F and special 5% tax free dividend and 50% capitalized issue. ¶and 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. J and 75% capitalized issue. Q also 1/– special tax free dividend and 50% capitalized issue. T Per £1 unit. K Forecast dividend. S and 50% capitalized issue. V incorporating Clifford Covering.

The Thomas Bolton Capital has been acquired by British Insulated Callender's Cables.



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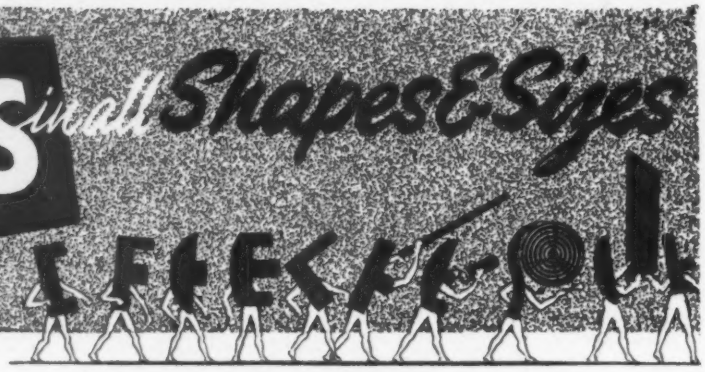

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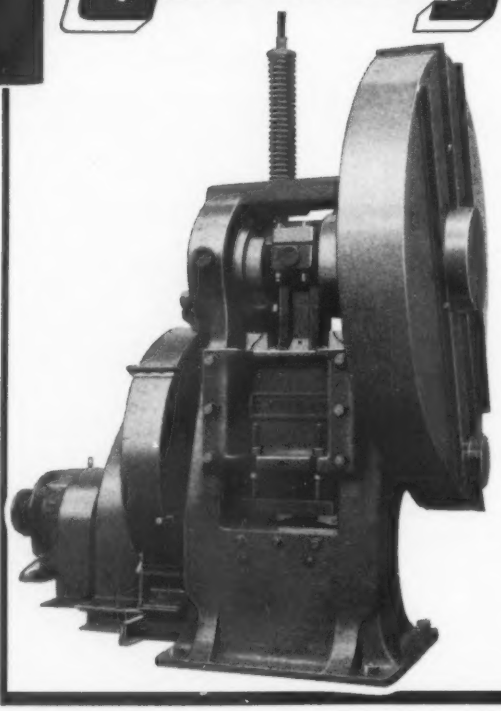

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★ ***CONTINUOUS PRODUCTIVITY***

TECHNICAL REPORTS

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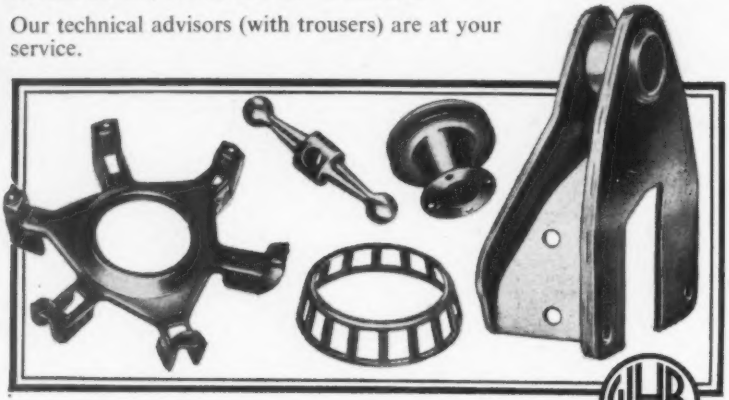

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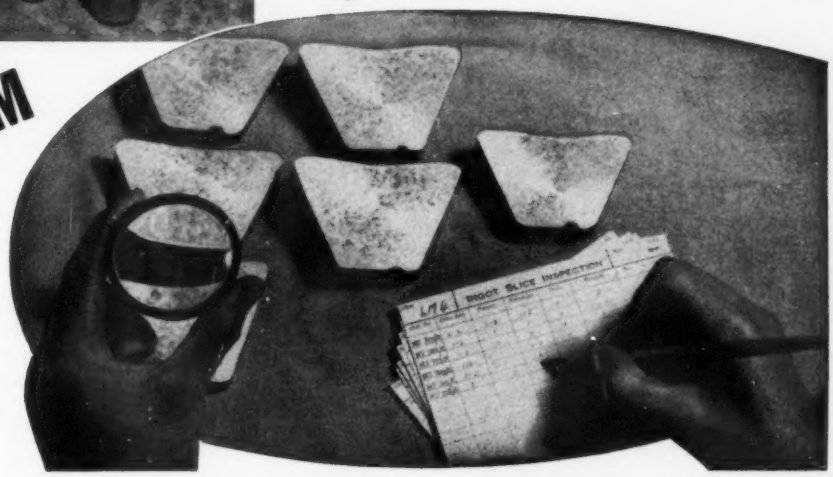

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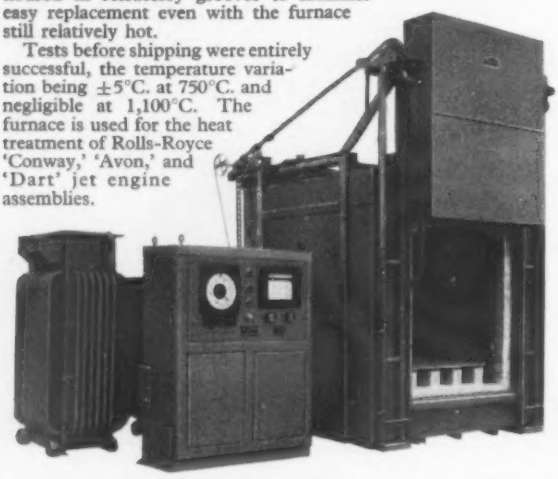

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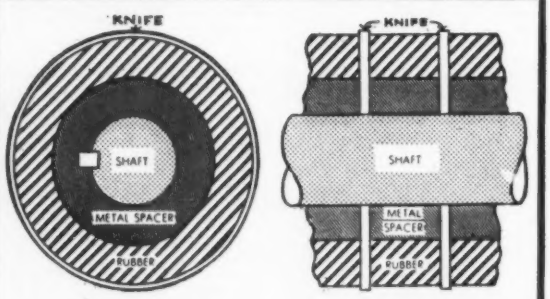

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